RAILROAD GAZETTE

FRIDAY, JULY 4, 1902.

CONTENTS

Contributions

Burroughs Adding Machine.

St. Louis, June 24, 1902.

TO THE EDITOR OF THE RAILROAD GAZETTE:

In your account of the Burroughs adding machine June 20th, page 482, a mistake has been made in stating the capacity of the machine. You say: "By its use 300 items can easily be listed and added in a single hour." An ordinary accountant can easily do this. Three thousand items can be easily listed and added by the machine in a single hour. So that this mistake has reduced the capacity of the machine nine-tenths. If it would only add and list 300 items an hour, no one would want it.

AMERICAN ARITHMOMETER CO.

Griffin Wheels in Russia.

ODESSA, RUSSIA, June 4, 1902.

TO THE EDITOR OF THE RAILROAD GAZETTE:

In your issue of May 23 appears an article on the subject of Griffin wheels in Germany. It seems to me interesting to make known to your readers the fact that the Griffin wheels are also used in Russia. The Steel Works of Odessa secured the rights to make Griffin wheels in Russia, and has made them now for two years. For this purpose the Works have employed a specialist from the New York Car Wheel Works at Buffalo, namely, Mr. H. Gulden, Engineer. These works supply Griffin wheels to various railroads in Russia. By an order which appeared in the Official Journal of Russian Railroads, the Minister of Ways and Communication permitted the introduction of Griffin wheels on the Russian roads under freight cars without brakes, and permitted them to be used up to 10 per cent. of the total freight wheels.

FRANCOIS, *Controller, etc.*

Steel Rails: Relations Between Structure and Durability.*

BY ROBERT JOB, *Chemist to the Philadelphia & Reading.*

An investigation was begun some time ago at the Test Department of the Philadelphia & Reading Railway, to determine qualities in steel rails which resulted in fractures or in relatively rapid wear in service, and to work out the means necessary to reduce these to a minimum.

Arrangements were made to have forwarded to us a section of each rail which fractured in track or which was removed owing to undue rate of wear, together with detailed data regarding it. A considerable number of rails which gave good results in service have also been tested in the hope of finding fundamental characteristics which might account for the durability or the failure, as the case might be. Also, in our regular rail inspections at the mills, sections representing various methods of manufacture have been taken, and particular attention has been given to investigation of differences between rails which failed under the drop-test and those which passed it successfully. . . .

We believed that proper chemical composition is one of the essentials in obtaining the greatest durability in steel rails, but our work had confirmed that of others in proving that physical character and structure have at least an equal influence upon the final outcome. Accordingly, we have not limited ourselves to determining chemical composition, but have tried in each case to ascertain the definite cause of the weakness, whether chemical or physical.

Up to the present time about 200 defective rails have been examined. In some cases complete chemical analyses have been made; in others the loose, coarse-grained fracture or other physical character—such as piping—showed the cause at a glance, and in still others a rather elaborate investigation was necessary to prove the matter to a certainty. . . . Short life of rails is attributable to the character of the steel, and is seldom found where toughness, strength and solidity exist. . . .

We found from the start a marked difference in the structures, and note the following general characteristics in the rails which gave defective service:

(*a*) Coarse regular granular structure, Figs. 1 and 8 (50 diameters).

(*b*) Excess of foreign matters, such as oxides, slag and enclosed gas, Fig. 2 (reduced 50 per cent.).

Either characteristic resulted in relatively poor service.

On the other hand, in rails of the same general composition giving satisfactory service, we have found (*c*) a generally fine, interlocking, broken up, granular form, with

(*d*) Relative freedom from foreign matter and gas. Fig. 3, which will be referred to again, represents a coarse example of this finer structure, and Fig. 4 shows a characteristic structure of the head, reduced 54 per cent., showing freedom from foreign matter.

Upon comparing the above results with those obtained in our mill inspections we found complete accordance, for the rails of the character *a-b* proved exceedingly fragile under the drop-test of 2,000 lbs. falling 20 ft. A section of rail, Fig. 2, from center of head, gave an elongation of only 2 per cent. in a 2-in. section, with tensile strength of 118,000 lbs. per sq. in. The analysis of these rails varied from:

Carbon, .55 to .63 per cent.; phosphorus, .075 to .104 per cent.; manganese, .75 to 1.20 per cent., and sulphur, .034 to .07 per cent.

In contrast with this, rails when of the structure *c-d*, with the above composition, showed a marked toughness under the drop-test, and rail Fig. 4 stood 14 blows of the drop without fracture, turning after the first and third blows, and successive odd numbers. The composition was: Carbon, .644 per cent.; manganese, 1.09 per cent.; phosphorus, .081 per cent.; sulphur, .076 per cent., and a test piece from a similar rail, center of head, gave an elongation of 13 per cent. in 2 in., with tensile strength of 132,000 lbs. per sq. in.

These marked differences were not at all unexpected, for they simply confirm the work of others. . . .

Next we made a comparison upon a lot of about 50 rails which broke in track, each having had a life of less than five years. They came from different points upon our lines, and had approximately the composition stated above. A number of different mills were represented, but all of the rails could be grouped under the head of "coarse-grained," or of "finer grain," and upon figuring the fractures in each class to a basis of equal tonnage during the five years, we found an average of 15 fractures of the coarse-grained material to one fracture of the relatively finer-grained, and in each case of fracture of the latter, we found that the weakness was due to pipes in the steel—defective cropping. This comparison, of course, applies strictly only to actual fracture, but it is well-known that the same conditions which here have produced fracture also contribute to rapid wear in service. . . .

Turning now to the influence of mill methods upon the size of grain.

During the past 10 years marked progress has been made in knowledge regarding the metallurgy of steel, and, thanks to the work of efficient investigators, the general relations between structure of steel and its physical properties are so well proven that cause and effect in many conditions of mill practice have become matters of definite certainty. . . . Stopping thorough working of the steel while materially above the recalescent point, and allowing to cool slowly, can result only in coarse granular structure, and such structure, other things being the same, has been proved by Professor Sauveur, Professor Martens, Mr. C. H. Ridsdale, Mr. R. G. Morse, Dr. Sargent, and others, to lower elongation and reduction of area, and to lessen the general toughness of the steel. . . .

It will thus be seen that the unsatisfactory results which our service tests show with this coarse granular structure are merely the natural accompaniments of such character, and the entire investigation proves clearly the immense practical advantage in the betterment of quality which is being derived from the researches of metallurgists and metallographists, especially during the past decade.

The mills have not been slow to recognize the need of fine-grained structure in the heavier sections, and during recent years great efforts have been made to effect the change, and much progress has followed. At first, attention was directed merely to the finishing temperature. . . . High initial temperatures tended to prevail out of deference to the rolls, especially where these were light, or where the power was limited, and under such conditions it became necessary to hold the rails before running through the last passes, in order to finish at the desired temperature. The result of this procedure, as pointed out by Mr. S. S. Martin recently,* was to produce a fine granular form to the depth to which the working of the steel extended during these last passes, or to a depth of from ⅛ to ¼ in. below the surface of the head.

Our own studies had proved the correctness of this statement, and further showed that the size of grain at center of head was but little affected by such treatment, as shown in Fig. 5 (50 diameters). A surface toughening resulted, which should be of only temporary benefit, and could hardly from its nature cause any very decided increase in durability in service. The character needed is not a fine-and-coarse irregular structure, but one fairly fine even at the center of head, and practically amorphous at the surface; just such a structure, in fact, as we find in the rails of lighter sections rolled before the heavier sections came into use. Fig. 6 (50 diameters) represents the structure at center of head of a 67-lb. rail which was rolled and laid in 1864, and which withstood 34 years' heavy traffic, and since then has been in use in side track. The analysis is:

Carbon	.33	per cent.
Phosphorus	.039	"
Manganese	.390	"
Sulphur	.030	"
Silicon	.070	"

Fig. 7 (reduced 64 per cent.) represents the appearance of this rail in 1898, etched, and shows that it had evidently been greatly worn from its original section, and contained a pipe in the web. Tne metal, however, has not "flowed over" upon the side of head, although the steel is comparatively soft. The head is almost free from foreign matter, and the structure even at center of head is exceedingly fine.

"Flowing over" has been found by us to be practically independent of the composition, and caused generally by unwelded seams due to presence of foreign matter and gas in the steel. In 1890 Dr. C. B. Dudley stated that his studies of such rails "would seem to indicate that disintegration or crushing of steel is largely a resultant lack of soundness in the ingot, and is more mechanical than chemical, except in so far as chemistry may be responsible for the soundness of the ingot." In some cases, however, we have found almost complete freedom from unsoundness, but in each such instance a coarse granular structure was present. Dr. P. H. Dudley also states: "The mineral aggregates are large and friable, and the surface of the rail breaks down more than $^1/_{32}$ of an inch in depth, readily flowing under wheel pressures." Thus, it seems clearly established that such condition may arise from marked weakness due to any cause, whether unsoundness of the metal; weak, coarse structure, or even such composition or form that the rail is unable to support the load and becomes flattened.

In the case of the 67-lb. rail, Figs. 6 and 7, which gave excellent service, the composition is exceptionally free from defects. It is, however, a matter of common experience everywhere that the composition of these old rails of light sections is exceedingly irregular. . . . One such rail taken from our tracks contained .160 per cent. phosphorus with .44 per cent. carbon, but still had given long service. The one characteristic common to all of these rails is fine granular structure; in fact, it was necessitated by the conditions under which they were rolled, for the steel was thoroughly worked well down toward the critical point.

In order to note the exact influence of structure upon quality, we took at random from a heat which passed the drop-test a rail having the following composition:

Carbon	.56	per cent.
Phosphorus	.102	"
Manganese	1.08	"
Sulphur	.056	"
Silicon	.147	"

turned down a section at center of head and obtained the following results:

Tensile strength	128,400	lbs. per sq. in.
Elongation in 2 in.	8½	per cent.
Reduction of area	3½	"

The structure (50 diameters) at center of head is shown in Fig. 8, and the etched head (reduced 50 per cent., in Fig. 9. The former is very coarse, but the latter is tolerably free from foreign matter.

An adjoining portion of the same rail was then reheated to a cherry red, and let cool at once in the air. A test section was then turned from the center of head, having a structure (50 diameters) represented in Fig. 10, and gave the following results:

Tensile strength	129,500	lbs. per sq. in.
Elongation in 2 in.	12	per cent.
Deduction of area	10.1	"

It is thus seen that the change shown in the structure has caused an increase of strength, an increase of nearly 50 per cent. in elongation, and an increase of nearly three-fold in reduction of area, fully accounting for the marked difference observed in service between the coarser and the finer structures, respectively. . . .

In the foregoing we have seen that coarse granular structure seriously weakens steel, and that brittleness under the drop-test is found when in addition the metal is "burned" or contains an excess of foreign matter. The result of a large number of tests further proves that fracture under the drop-test seldom occurs if the steel is homogeneous and free from unsoundness. In other words, mere ability of rails of this composition to withstand the drop-test is no guarantee of fine granular structure, and consequently other tests of quality are essential to necessitate durability. Figs. 1 and 8 represent rails of coarse granular structure which passed the drop-test with good deflection, but such rails do not give satisfactory service.

*A paper read at the Joint Meeting of the Mining and Metallurgical Section, Franklin Institute, and the American Institute of Mining Engineers, held Wednesday, May 14, 1902, at the Manufacturers' Club, Philadelphia.

**Railroad Gazette*, Jan. 3, 1902; *Iron Age*, Dec. 26, 1901.

The foreign matter and gas which produced brittleness was generally found in small cavities or lines scattered throughout the section, but especially prominent within ½ in. from the surface around the head, and caused a series of unwelded seams—elements of weakness. The appearance was usually similar to that of Fig. 2. Rails which did not fracture under the drop-test at the same rolling were found comparatively free from this enclosed matter around the outer portion of the head, though in some cases a considerable proportion was found nearer the web. Still, the solid band of homogeneous material around the outside of the head gave sufficient toughness to the rail to enable it to resist the force of the drop. It is of interest, however, to note that an excessive proportion of foreign matter and gas in rails may not cause failure under the drop-test in cases where the grain is comparatively fine, since the strength incident to such structure may offset the weakness caused by the unsoundness.

A typical case came under our observation not long ago. A lot of 90-lb. rails had been rolled, and had passed the drop-test without a single failure, and the average structure was somewhat finer than that represented in Fig. 3. After being in tracks for a few months a number of the rails began to flow over and break down under which break up the continuity of the steel and produce planes of weakness. In order to learn the extent of these defects, we polished off a full section of the rail and etched lightly with iodin, finding that the entire surface of the section was covered with lines of unwelded seams, as represented in Fig. 11 (reduced 52 per cent.). Microscopic examination showed that the steel contained a large number of particles of foreign matter—Fig. 13 (x 50 diameters)—and that some seams were coated with blue and brownish films, evidence that the steel had been burned, and fully accounting for the failure to weld. Fig. 3 gives a section from center of head, and proves that the rail was worked and finished at a moderately low temperature, and that owing to the consequent fairly fine structure the rails withstood the drop-test in spite of the weakness due to defective manufacture. When laid in track, the weight of the rolling stock caused the unwelded seams to slip apart at the portion where the greatest strain came, thus resulting in the breaking down of the rails. The upper right-hand corner of Fig. 11 shows where a sliver ½ in. thick was forced out of the side of the head along one of the unwelded seams for a distance of several feet, and the crack along the seam extended nearly to the top of the head.

This instance proved conclusively that reliance could

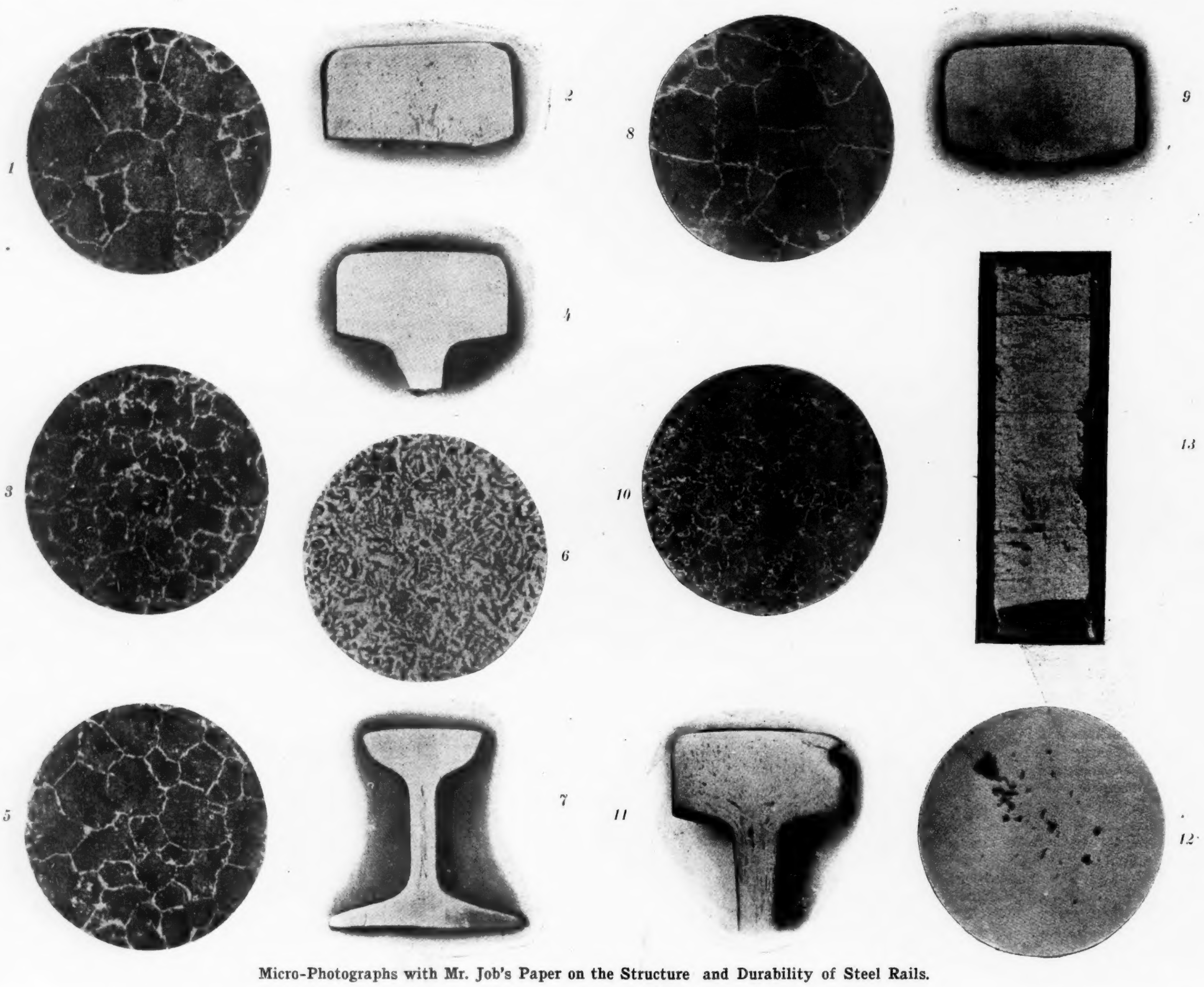
(2) Absence of unsoundness is best ensured by careful inspection throughout the manufacture, and by specifying, a definite proportion of cropping.

(3) Fine granular structure is necessitated by specifying, under definite conditions, the shrinkage of the rail after leaving hot saws—an idea suggested by Mr. Wm. R. Webster.

A shrinkage limit is in operation in most of the mills to-day, but it must be borne in mind, as pointed out by Mr. Martin in the paper above referred to, that specifying merely the distance between hot saws does not compel presence of fine grain clear to center of head. Such structure will not result unless the reduction in the passes after the holding is sufficient to work the steel thoroughly to the center.

What is needed is a moderately low initial temperature, sufficient work to render the steel solid, the speed of train and extent of reduction being such that with rapid rolling—without undue holding before or in the last passes, and without artificial cooling subsequently—the distance between hot saws shall not exceed a specified amount.

Under the above conditions, with a given composition, the extent of shrinkage of the rail after leaving hot saws may be made a definite guarantee of size of grain in sections of a given weight, and if the limit is placed at 5½



Micro-Photographs with Mr. Job's Paper on the Structure and Durability of Steel Rails.

the heavy traffic to such an extent that replacement became necessary. Upon inspecting the track we found that some of the rails from the same rolling were in good condition, showing little wear, while others next to them were badly broken down, often along the entire length. The defective rails were not confined to any one heat, but were scattered throughout the rolling. Sometimes the outside edge of a rail was broken down, and sometimes the inside edge. Some in a given heat were showing good service, while one or more from the same heat were defective. Eighty-lb. rails of practically the same composition had previously been in this track and had given good service, and had not been broken down by the same traffic.

In order to get at the cause of the difficulty, sections of some of the defective rails were obtained, and showed the following average composition:

Carbon	.544	per cent.
Manganese	1.005	"
Phosphorus	.078	"
Sulphur	.090	"
Silicon	.120	"

There was nothing abnormal in this, and many rails of essentially the same composition have given good results under heavy traffic conditions.

We next investigated the structure of the steel. Fig. 12 represents the general character of the fracture magnified to 1½ diameters, and is a longitudinal section down through the head of the rail about ½ in. from the center line. The striations which appear are unwelded seams not be placed upon the drop-test to ensure homogeneous, solid steel, and it is generally well known that rails of laminated steel may give even a better test under the drop than if composed of solid metal of the same composition.

The above results clearly verify the statement of Dr. P. H. Dudley that solidity and continuity are quite as important as a good microstructure.

As to the origin of foreign matter in steel, it is evident that it must be due to defective mill practice either in the manufacture of the steel, including teeming and settling; in burning of steel in soaking pits—or in blooming furnaces, if the latter are used—or in cropping blooms or rails; in any event, it is an unquestioned proof of defective mill practice; and is easily avoided if so desired.

In order to ensure the most durable rail of a given composition, our service results, as shown above, indicate that there must be:

(1) Freedom from brittleness.
(2) Absence of unsoundness.
(3) Fine granular structure.

(1) Brittle rails are eliminated by the drop-test of 2,000 lbs. falling 20 ft. upon a rail-butt from the top of the ingot, one rail from each heat being tested, or, in case of fracture, two more being taken from the tops of other ingots of the same heat; fracture of two out of the three causing rejection of all rails in the heat.

in. for a 30-ft. length of a 90-lb. rail, coarse grain even at center of head is practically impossible.

It is, of course, obvious that mere fine grain does not render certain freedom from brittleness, as, for instance, in the case of the St. Neots rail, where the steel was fairly fine-grained, but was fragile owing, it is said, to presence of martensite due to rapid cooling from a high temperature. Such composition was, however, evidently caused by a very exceptional accident in mill practice, and is carefully guarded against under normal conditions.

In working toward the most efficient practice in rail rolling, valuable aid has been given during the past few years by Committee No. 1 of the American Section of the International Association for Testing Materials, and Mr. Wm. R. Webster, the chairman, deservedly receives great credit for his efforts in bringing together the various conflicting interests, and in formulating proposed standard specifications of various materials of construction. The specifications for steel rails in particular have aroused wide discussion. In its present form we regard it as tentative, since it merely specifies the quality which, since the introduction of the heavier sections, has everywhere been found rapid wearing and unsatisfactory. It does not ensure durable material, and it does not represent the best American practice. . . . The specifications proposed to the American Railway Engineering and Maintenance of Way Association are an improvement over those of the International Association in inserting a

shrinkage clause, but the wording of the latter is open to the objection cited by Mr. Martin, and would ensure fine-grained material upon the immediate outer surface of the rail. . . .

The Master Mechanics' Convention.

The thirty-fifth annual convention of the Master Mechanics' Association was called to order at 9:30 a. m. on Monday morning June 23, at Saratoga Springs, N. Y., by President A. M. Waitt. There was an address of welcome by Mr. A. B. Knapp, President of the Village of Saratoga. After replying briefly to Mr. Knapp's address, the President delivered his annual address, extracts from which follow:

PRESIDENT'S ADDRESS.

. . . Statistics compiled for the year 1901 showed the total output of the eight principal locomotive building plants of this country as 3,384, or 7 3/10 per cent. more than in 1900. For the year ending June 1, 1902, the record of locomotive building has exceeded even the year 1901. The reports of five locomotive manufacturing companies indicating an output of 3,638, which is a total result beyond what has ever before been reached. Of these locomotives about 540 were for passenger service, 2,380 for freight service, and the balance for switching and miscellaneous uses. Eighty per cent. were for use of bitumious coal; 10 per cent. for anthracite, and the balance, 10 per cent., for oil or other fuels. Of the bituminous coal burning standard gage engines, about 50 per cent. were constructed with so-called wide fire-boxes, extending beyond the outside of frames. During the past year about 30 per cent. of the total of passenger and freight engines built by the two largest locomotive manufacturing companies were of the compound type.

. . . During the past year engines have been constructed for passenger service with over 3,500 ft. of heating surface, and freight engines with 5,390 ft. Most of the simple engines constructed carry 200 lbs. pressure, and some have been designed for 225 lbs. At the present time it seems to be a conceded fact that with 200 lbs. pressure the economical limit for simple engines has been reached, and that for higher pressure the compounding feature is necessary for economy in fuel consumption.

During the past two years the limitations of the two-cylinder compound engine have been reached and passed. The required dimensions for the low pressure cylinders for two-cylinder type on the heavy engines of recent construction exceed the possible clearance limits for side tracks and switch stands, and the space between the necessary location of the center of cylinder and top of rail. Two alternatives seem to be presented, namely, the tandem or the four-cylinder compounds.

The tendency in locomotive design at present is toward a greatly reduced ratio of the grate surface and heating surface to the weight on drivers for engines burning bituminous coal, and it would appear, from the satisfactory results obtained from locomotives of recent design that the former standards of good practice recommended by this Association must be materially revised.

In past years failures to make steam in sufficient quantities to reliably handle heavy passenger trains at high speeds have been rather frequent. A little examination of the relation between the heating surface and the work expected from the locomotive will readily indicate the necessity for very different ratios than have been used in past years. It is a conceded fact that the weight on the driving wheels gives the limit to the power that can be exerted by a locomotive in handling a train. . . . Taking the weight on the drivers as an indicator of the power expected from the locomotive, and assuming a proper proportioning of the cylinder and diameter of drivers for the work to be performed, we must naturally look to the source of steam production, which is the boiler. The amount of steam produced, of course, depends upon the coal consumed (either economically or otherwise), and the evaporative efficiency of the boiler. Assuming a boiler of reasonably good design, the evaporative efficiency will be closely proportionate to the amount of effective heating surface provided to conduct the heat from the incandescent fire and hot gases to the water. An analysis of the vital proportions of engines that were considered marvels in their day, ten years ago, shows the ratio of heating surface in square feet to the weight on drivers in pounds as about 1 to 45 for passenger service. The once famous 999 of the World's Fair period had the ratio of 1 to 43.5. Engines built with the same weight on drivers for heavy or fast passenger service during the past two years have this ratio 1 to 30.5. Though both are capable of starting trains of corresponding weight, the 1893 class fails in the long run, consumes more coal per unit of work performed, and as a consequence has been consigned to services without either honor or good record. The 1901 class, with the 1 to 30 ratio, and same driving wheel weight, does more work with less fuel, and with rare failures. As a suggestion worthy of consideration, and the result of no small amount of observation and computation, let me recommend that in new locomotives designed for the best results under present conditions, that, for passenger service, engines burning bituminous coal should have a ratio of heating surface to weight on drivers of not more than 1 to 30. Some of the best working locomotives now in service have this ratio as low as 1 to 27. For heavy freight service, where the speed is going over a division of from 100 to 150 miles averages from 15 to 20 miles per hour, the ratio should not exceed 1 to 50. For switching service, where demands for steam are less continuous, a ratio of 1 to 75 will produce excellent results.

For some years past many of the railroad companies have been giving considerable attention to the tonnage rating of engines. In the excess of zeal to load engines up to their full rated capacity the factor of average speed and resultant time in getting trains over the road was many times lost sight of, and engines were loaded to a point where they could only just drag the train slowly over the line, resulting in frequent stalling, breaking in two, and greatly increased wear and tear on both power and equipment. Better judgment has shown that slightly lighter loading has resulted in an increased gross engine ton mileage, more satisfactory time record in delivery of freight, greater contentment of enginemen and trainmen, and much less expense for maintenance of engines and for repairs of cars.

All efforts of the executive officers of our railroads have the object in view of increasing the difference between the cost of operation and the revenue received for handling traffic. There are several lines of action in which the motive power department officials can materially assist in bringing about a decrease in operating expenses and an increase in efficiency of operation.

Prominent among these I would name system and organization in department work. The past two or three years have done much toward bringing many lines having independent organizations into closer business relations than heretofore. This has been brought about by consolidations, leasing, purchase, or as a result of the merging of a "community of interests." The result of such moves is to bring about a more uniform general policy; to give better service to the public: to standardize methods and equipment, and to reduce friction. . . .

Good shop practice and methods is another source of money saving for railroads. Much can be done in reducing loss in operation by furnishing good, modern tools and keeping them in good condition. . . .

Care in the seclection and purchasing of good material, under carefully prepared specifications, will reduce to a minimum the loss from poor material, and will increase the wear of the parts made. . . .

The size of locomotives of recent design is such that the limit has almost been reached for the capacity of a single fireman to properly fire the engines. If any further increase in the size of the fire-box is contemplated, it may be necessary to install an automatic method of stoking. In many of the engines put in service during the last three years, an automatic stoker would, undoubtedly, be the means of considerable economies in the burning of coal.

A great deal has been said and written in regard to smokeless burning of bituminous coal, and many devices have been presented with that end in view, but none of them, in past years, seems to have met with success. Happily this condition no longer exists, as experiments during the past year have clearly and fully demonstrated that there are one or two practicable devices in actual operation by means of which the poorest grades of bituminous coal can be burned with absolute freedom from black smoke, and with only an occasional trace of light brown smoke, regardless of whether the engine is working steam or is shut off. On the New York Central & Hudson River Railroad a device of this kind has been in successful operation on one locomotive for about ten months, and since Jan. 1 it has been applied to 10 or 12 additional engines, with such success that it has been specified on new equipment. The saving in coal, with the smoke consumer, is an important feature in its favor. . . . Reports made by road foremen of engines in charge of some of the engines on the New York Central indicate a saving of 15 to 20 per cent. in service on a division with a 148-mile run.

The recent discovery of large quantities of petroleum in the Southwest and on the Pacific coast has almost revolutionized the type of fuel for locomotives on roads in the extreme west, and it has started pointed inquiries and investigations as to the possible economies and advantages of liquid fuel on roads in the Middle and Eastern States.

. . . Water supply for locomotives has an important bearing upon the economies of the motive power department. The water supply on many roads is an unknown quantity. . . . There is need of systematic study to obtain the best possible quality of water. In cases where a fair quality of water cannot be obtained from natural sources, the introduction of methods for purification of the water before it is introduced into the tank or boiler should be carefully considered.

Among the means for improvement in locomotive service a careful and systematic study of engine failures will be found productive of great good. In order for this to be the most beneficial there is necessity for complete information, and a record of each case, followed by the weekly or monthly tabulation of the cases under their appropriate headings, and a careful study of each class, and the causes producing them. Such a study will enable the weak parts or those of defective design to be quickly located, and necessary modification in design made. . . .

If I may make suggestions as to lines of future usefulness of the Association, I would say that with its present standing as a progressive body of railroad men we might profitably inaugurate tests and experiments affecting locomotive performance, looking to a better understanding of the possibilities of obtaining reserve power, which is so greatly needed, experiments on various lengths of boiler tubes, the relative values of various kinds of heating surfaces, the possibilities of ribbed or corrugated boiler tubes, of the Serve or Whitney types. . . .

I would recommend that a committee be appointed to revise and retabulate the Standards, Recommended Practices and Standing Resolutions of the association, many of which are not now up to date.

I would also recommend the establishing of a standing committee to report to the association from year to year on the progress of the year. Data of this kind has in the past been taken up in a cursory manner by the President in his address, but in the hands of a standing committee the progress in railroad mechanical matters could be made of greater value and more complete than the limited reference only that can be allotted to the subject in the opening address.

. . . The work of the various railroad clubs is rapidly taking on a higher character and value, and it behooves the Master Mechanics' Association to look out for itself, or these clubs will soon be doing its most important work. . . . We should study the real problems of motive power, and discuss progress, with a view of making our department fill its important place, so that it will be recognized because of its real grasp of its business problems. Not that this has not been done to a large extent in the past, but there is room for filling a much larger and important field in our future work. . . .

The reports of the Secretary and Treasurer show the continued prosperous condition of the Association.

We now have a total membership of 712, an increase of 5 per cent. over last year, and of over 1,700 per cent. since 1868.

Our financial condition is of the best, with a fund above all indebtedness of $2,700.89.

The scholarships in the Stevens Institute of Technology are all filled, and there are applicants still in waiting for the first vacancy. . . .

Appreciation of the value of the mechanically trained man in the higher official positions of the operating departments of our railroads has been shown the past year by the selection and advancement to high positions of several of our members, including our First and Second Vice-Presidents. There are no departments in the railroad service which develop men in a broader manner to occupy high executive positions in the management of our railroads than the mechanical department, coming in contact as it does with more or less of the detail and troubles of every branch of the service. The numerous selections from this department during the past few years for general superintendents, general managers and vice-presidents should be an incentive for bringing out the best and broadest work possible in the development of American railroads by the members of this association.

In conclusion, I desire to congratulate the Association upon its prosperous condition, and I wish to thank the elective officers and our able and energetic Secretary for their hearty co-operation during the past year, and I bespeak your active participation and support in the work of the convention of 1902, which is now before us.

The minutes of the previous meeting were approved, and after a motion to appoint a committee to carry out the recommendations in the President's address, the Secretary read his report, showing a membership of 712. The Treasurer's report showed a balance of $2,700.89 on hand. The dues for the current year were made $5, the same as formerly. Messrs. F. M. Whyte, David Brown and F. A. Chase were elected an Auditing Committee.

The following were elected to honorary membership in the Association: Mr. Amos Pillsbury, Portland, Me., a member since 1878; Mr. James Stourd, Elmira, N. Y., a member since 1875, and Mr. Charles Blackwell, Cleveland, O., a member since 1883.

The following committees were appointed by the President: On Correspondence and Resolutions—J. H. McConnell, F. M. Whyte and L. R. Pomeroy.

Committee on Subjects, 1903—D. F. Crawford, G. R. Henderson and C. H. Quereau.

Committee on Obituaries—For Angus Brown, James McNaughton; for W. L. Hoffecker, William McIntosh; for J. H. Buckalew, R. H. Briggs; for Jerome Wheelock, G. A. Coolidge; for J. H. Leeds, G. M. Basford.

TON-MILE STATISTICS.

[*See the Railroad Gazette, June 27, page 488.*]

Mr. C. H. Quereau (N. Y. C.)—The report is really a discussion of the matter of ton-mile statistics summarized in resolutions, with a view of these resolutions being acted upon by this convention, and if the action is favorable, that the resolutions shall be presented to the American Railway Association. It is a discussion of the question, as I have indicated. The adjusted tonnage, as has been discussed here, does not represent the actual tonnage handled; but a certain percentage passes for light cars, for the different weights or capacities of the cars. If the same system of adjusted tonnage was in use on all roads, a comparison could be made, but although there are several systems of adjusted tonnage ratings, the same system is not in service on more than one road. Therefore, a comparison between two or more roads would not be fair, and would really be impracticable.

Mr. David Van Alstine (C. G. W.)—Would not any system of adjusted tonnage be a more accurate comparison than the ordinary ton mileage system? Would not any adjusted tonnage be nearer the actual figure than the ordinary ton mileage?

Mr. Quereau—I am very much inclined to doubt that, because the adjusted tonnage takes into consideration grades and curves, and as the adjusted system of tonnage rating is applied to a system where the conditions are variable, each system would differ materially in all probability. For instance, the difference between the power required to haul a ton of light cars and loaded cars decreases with an increase in grade; in other words, the difference between the power required to haul a light car and a loaded car on a 2 per cent. grade is less than on 1 per cent. grade, and that is less than on a ½ per cent. grade. The difference between those two classes of tonnage is less the slower the speed, and is greater the higher the speed. For instance, at 30 miles per hour it requires approximately 50 per cent. more power to haul a ton of light car than a ton of loaded car, while it would be reduced to 7 or 8 per cent. at a speed of eight or ten miles. You can see the difficulties you would get into if we use any comparison for different railroads, as to the ton-mile statistics derived from these adjusted tonnage ratings. Now, coming to the comparison of statistics for a given division, the conditions are settled and would remain the same on the division year after year, whatever changes there might be in grades or average speed would be known, and would be a legitimate feature to be included in the statistics for that division.

The report was adopted.

Mr. Angus Sinclair (Loco. Eng.)—I move that the resolutions just adopted be referred to the American Railway Association, with a statement of the action taken by this Association. Carried.

Mr. Quereau—There is one matter which ought to be given to a committee. The point I refer to, to consider which a committee might be appointed, is to determine what is the proper credit of ton-mileage for switch locomotives. This committee has not covered that point, but it should be covered in order to make the resolutions effective and complete.

Mr. Symington—I move that the same committee be requested to report on this particular proposition next year. (Carried.)

RELATIVE COST OF RUNNING TRAINS AT SLOW AND FAST SPEED.

Prof. W. F. M. Goss (Purdue Univ.), a member of the committee, presented the report, and said: "In supplementing this presentation with a word of discussion, I would say that the data which Mr. McIntosh presents as an appendix to this report are data which I have not had an opportunity to study, but concerning which I hope Mr. McIntosh will speak.

Mr. Wm. McIntosh (C. R. R. of N. J.)—There is very little to be said aside from what is contained in the appendix. As is pointed out, it is a very difficult matter to make tests of this kind within the limitations of ordinary service. In our attempt to bring out some data based on this test, we were disappointed in many ways. As stated in the report, it is more interesting in illustrating the difficulties than instructive for its records.

Prof. Goss—It seems to me that if the consideration of this question be narrowed to the locomotive and made simply one of determining how much fuel is required to do work at different speeds, that we are reasonably safe in depending on the results presented by Mr. Delano, in the report of last year, which are confirmed by those presented this year by Mr. McIntosh. Assuming the locomotive to be well adapted to the service required of it, if we base comparisons upon time, we shall find that the increase of power and consequently the increase of fuel required is practically proportional to increase of speed. If we base comparisons upon distance traversed we shall find that the coal required is practically the same for high speed and for low speed, this statement applying within such limits of speed as are now common.

Mr. L. R. Pomeroy (General Elect. Co.)—In the figures presented in Mr. Delano's report the principal increase in cost was in the cost of the coal; and as the average of all cost is $1 per train mile for operating a train, an increase even of 50 per cent. in coal consumption, as the coal consumption only makes 8 per cent. of all, would be insignificant in the total cost due to increased speed of the train.

Mr. R. D. Smith (B. & M. R.)—If the Association will defer action on the matter until to-morrow, I hope to have such a communication from Mr. Delano. I suggest that further action on the topic be postponed until to-morrow.

Further discussion was therefore postponed until Tuesday.

ELECTRIC DRIVING FOR SHOPS.

[*See the Railroad Gazette, June 27, page 493.*]

The President—We will now take up the paper entitled "Electric Driving for Shops," by Mr. C. A. Seley, formerly Mechanical Engineer of the Norfolk & Western.

Mr. George L. Fowler—This matter of electric driving of shops has been brought up frequently, but there is one point which I do not notice touched on in the paper which is all-important, and that is the question of economy. Certain tests have been made in cotton mills and machine shops where it has been possible to make a comparison between the cost of driving by electricity and with the ordinary shaft methods. In both cases, where such comparisons have been possible, it has been found that there is comparatively little difference, and what difference there is, is in favor of the shafting; that, if it is a shop where all of the machines can be considered as one unit and driven from a line of shafting, it is cheaper to belt all the machines directly to the shafting than it is to put in an electric drive either in large or small units; but that is a comparatively insignificant factor in the total of shop expenses, and if the other savings which come in from the use of electric driving are taken into consideration, there can be no comparison whatever in the favor that would be shown to the electric method. For example, you put in a line of shafting, with the counter-shafting, and the whole ceiling is occupied, leaving no room for hoists or traveling cranes, and the expense of handling material in and out of the tools is increased over what it would be with electric driving, where you would have the facilities for putting these helps in. In one shop with which I am familiar, a boiler shop, they found that the saving in labor was about six times the extra expense of using the electric drive. That, I think, would be the experience in almost any machine shop where it is necessary to handle work in and out of tools very frequently, which is one of the great arguments in favor of the use of electric driving. In such a case as the repair shop, and any other railroad shop, where power must be distributed over wide areas and you want individual units for various departments, one central power plant distributing the power all over the premises is, of course, much more economical than using independent engines with their independent attendants scattered over the premises; and even for the simple case where one shop is standing by itself and is using one source of power, the saving effected by the handling of material is much greater than the extra expense of the use of the electric motors, as compared with steam engines. These are the general reasons for the advocacy of electric driving in most of the railroad shops of the country, and more particularly in the case of new plants.

Mr. R. V. Wright (P. & L. E.)—In designing our shops, which we are about to build at McKee's Rocks, we have gone over this power question thoroughly and have decided to use, to a large extent, the individual system. There are a number of reasons why we have done this, but I will only touch upon two of them. We find that we can get a clearer head-room and can use cranes so that we can easily handle our material; the other advantage we expect to gain is by the variable speed. With our lathes as designed now the steps between the different speed are quite large. With the use of a variable-speed motor, we can make the differences much smaller in stepping from one speed to another. For instance, not very long ago our Master Mechanic in going through the shop found that in turning down a crank pin the speed seemed to be altogether too slow. He stopped at the machine and instructed the man running it to throw on the belt a step higher. The man did so and burned his tool right off. Now, it was perfectly evident that the machine was running too slow, but we could not speed it any higher, because the next step was too high. With a variable-speed motor you can make a smaller step, and the man can get just about the speed which the tool will carry.

Mr. G. W. West (N. Y., O. & W.)—I ask Mr. Wright whether they considered steam-driven tools in comparison with electric-driven tools and what the first cost of the two systems would be.

Mr. Wright—When we first started to work on the plant the question was taken up as between steam power and electric power, and we decided to use the electric power, after going into the matter very closely. We first decided to use the group system entirely, but the advantages of the variable-speed individual motors were called to our attention, and while at first we were very skeptical on the subject, we were finally led to believe it was the best thing we could do.

Mr. West—I do not think Mr. Wright understood me about considering the cost of steam-driven tools; the relative cost between driving tools by electric power and by steam power. Did you take these matters into consideration?

Mr. Wright—In the first place we did, and decided in favor of electric-driven machinery.

Mr. T. R. Brown—I have no actual figures of economy at hand, but it may be interesting to tell the members here that the works of the Westinghouse Air-Brake Company are equipped entirely with the two-phase, alternating current type of motor, which you probably know is an induction motor, and consists purely and simply of two bearings in the center of a field. We have in the neighborhood of 200 machines at the present time, and we use the group system, as far as the machine shop is concerned, except in the case of one tool, and that is a recent acquisition. The capacities of the machines driven by motors run from 25 to 30 h.p. and the number of machines per motor will vary from 50 to 100, according to the size. Most of the work is sufficiently light to easily handle without using hoists, and the total number of motors in the plant is taken care of by two men. The only attention which the motors require is the cleaning out of the bearings and giving them a little oiling, which is done at intervals of two weeks apart. The point has been raised, for instance, as an object lesson, that if one source of power supplies 100 or 150 machines, in circuit, and any accident happens, all these machines have to stand still until the defect is remedied. I will say that covering a period of a year and a half, I do not believe that motors on the main operating floors have been idle a total time of two days. The simplicity of the motor, the ease with which it is started and the amount of overload it will stand, quite high potential, is very much in favor of this type of motor for the purpose for which we are using it. There is an excellent installation or application of both systems, the grouping and the direct-driven, at the Westinghouse Electric Company's Works at Pittsburgh, where they have both large and small tools and use both systems with this same kind of motor.

Mr. Quereau—There is one feature of the paper on which no particular emphasis is laid, and yet it is one which I think is well worth considering, and that is whether the power should be delivered by belt or by gearing in the case of individual or small group-driven machines. I have in mind a plant built within the last two years where gearing is used as the means of delivering the power of the motor to the machine. I am told that it is very difficult for the foreman to convey his orders intelligibly to the men at the machines on account of the excessive noise.

Mr. West—I ask some of those members who have had more experience in electrical driving of machinery how they rate their motors. The road with which I am connected, when it remodeled the shops, decided to drive a portion of the machinery by electric motors. I do not remember the capacity of the engine formerly used to operate the machinery in the planing mill, but I know we decided on using one-half of its horse-power in driving about one-quarter of the machinery by electricity. Included in that machinery was our planer for dressing sills, and notwithstanding we had given about one-half of our engine capacity to this one-quarter of the machinery, we found it was impossible to operate the machinery. In starting the planer we would invariably burn out the motor. If the ratio had been carried out over the entire plant, we would have been required to purchase electrical machinery four times the rated horse-power of the steam-driven machinery.

Mr. T. H. Symington—I think the point just raised is not a question between steam-driven machinery and electrical-driven machinery, but a question of grouping or individual machines. If you divide up your steam engines around your shop, I think you would find about the same proportion of increase of horse-power with the steam machinery as with the electrical machinery. It is a well-known fact that a planer consumes a great deal of power; where the whole shop is run by one engine, that one engine cannot meet a heavy demand made on it by one machine, without serious detriment to another machine. That is entirely a question of individual operation of the machines or running them all from one engine.

The President—One of the questions which comes up now in the design of shops to be equipped with electric power seems to be as to the direct or induction current motors and the voltage; considerations, no doubt, that some of those present have given thought to.

Mr. Van Alstine—It seems to me there is a good deal lacking as regards definite information as to the cost of the direct-current system and the alternating-current system. I believe there are a good many shops, notably one I had in mind, on the Pennsylvania which keeps accurate daily logs that give a great deal of information. It occurs to me it may not be a bad plan if we had a committee appointed for another year to get together such information.

Mr. William McIntosh—The road I am connected with has recently built large shops and the machinery is driven by electricity entirely. We have not confined ourselves to either the individual or the grouping system, but have used them both. In some places we find it of advantage to drive our machines in groups, while our large tools are driven by individual machines in nearly every case, the heaviest and slow moving machines by gearing and the lighter ones generally by belting. We have endeavored in every case where we use belts to obtain a length of 8 ft. The system we are using is the direct current.

Mr. Seley—In regard to the general proposition of electricity, I would say it is a matter for each individual case to determine whether anything can be saved by having a central station which can economically distribute power from a central plant supplying current to separate portions of the works. Where you have an engine directly attached to the shafting, when you have shafting and belting there is friction of the engine, friction of the main belt, friction of the shafting and friction of the transmitting belting between the several sections on that shaft. Against that, as an offset, you must put in the friction of the engine-driven generator, loss in generator, losses in the wire, losses in the motor and the losses in the connections.

Transmission of material, of partly finished and finished products, is of prime importance and overshadows every other consideration. If we can facilitate the movement of material by overhead cranes so as to make a large daily saving in the cost of operating the shop, it is time to consider the facilities for putting in these cranes, and if necessary, cutting down the line shafting out of the way and driving by individual motors. But each shop must figure on its own basis, and I think that a combination arrangement whereby small tools can be group-driven and large tools and isolated tools driven independently will be the best solution and give the maximum return for a minimum of expense.

As our chairman has well brought out, the paper is

specially written in reference to the old plants. We have lots of old shops in this country, shops which work at a disadvantage in regard to the movement of material primarily, and cost of generating power secondarily. Many of these shops can be very materially improved in the costs of production, by facilitating the movement of material and decreasing the cost of power by the use of electricity.

The individual motor-driven machines require a variety of motors, running from 2 and 3 h.p. up, and this variety of motors means a large bill for maintenance, for the repair of parts, etc. The large motor for group-driving can be made a standard motor for a plant to a considerable degree. For instance, in the shop referred to in the paper a 20 h.p. motor was made, as far as possible, the standard motor; and while it is true that there are 10, and 15 and 25 h.p. motors in that shop, still the 20 h.p. motor was made standard so far as possible. In regard to alternating-current systems I will say that I have never seen but one railroad shop operated by that system. I refer to the shop at Fort Wayne. There are conditions in that shop which justify the use of the alternating current. As I understand it, they operate over a long, narrow strip of territory, requiring electricity at one point several miles in one direction and at another point several miles in the opposite direction, and the shops are located in the middle of the plant. Furthermore, they have no cranes.

Mr. Van Alstine—I would move the appointment of a committee for another year to present statistics and information bearing on this question. (Carried.)

TOPICAL DISCUSSION.

Is the Master Mechanics' Association's Standard Front-End Arrangement Best Adapted to the Modern Locomotive Having Wide Fire-Box, Increased Length of Flues and Larger Grate Area?

This topic was to have been opened by Mr. James McNaughton, but in his absence Mr. John Player opened the topic.

Mr. Player (Am. Loco. Co.)—Our experience at the Brooks Works with engines having wide fire-boxes is that practically similar smoke boxes are equally adapted to such boilers as those of similar size and capacity having ordinary fire-boxes. The Master Mechanics' front end, as adopted by the Association, is, I believe, used on some roads, and modifications of it are used on a great many other roads. There are types of front ends which are used on a third class of roads, differing from the standard of the association, but the tendency of modern locomotive construction is to keep within the lines recommended by the Master Mechanics' Association as regards the dimensions and proportions of the exhaust nozzle and stack. We have found in the construction of large engines, having large boilers, that to obtain an efficient front end that will make a good steaming engine, it is advisable to keep the distance from the center of the exhaust pipe to the flue sheet more than was used upon smaller boilers; that is, as you increase the size of the smoke-box it is necessary to increase the distance from the center of the exhaust pipe back to the flue sheet in order to get an area back of the diaphragm equivalent to that used in smaller smoke-boxes. I think that is one of the most important features to be considered in the arrangement of a front end. With the diaphragm plate being placed back of the steam pipes in any arrangement of smoke-box, it does not seem to make much difference what arrangement of netting is used, whether that recommended by the Master Mechanics' Association, which is a curved netting leading from the exhaust pipe to the top of the smokestack, or whether it is brought out straight and run at an angle, or whether it is brought along horizontally and brought back diagonally nearly to the base of the stack or whether the arrangement known as the Snowden Bell arrangement is used. This is a series of two hoppers, the front one opening at the bottom with a piece of netting underneath. In our experience the Snowden Bell arrangement has given satisfactory results in many instances. In fact, in some cases it has given better results than the Master Mechanics' front end. The arrangement of the adjustable diaphragm plate, with this long distance from the center of the exhaust pipe to the flue sheet, seems to give the best results just back of the exhaust pipe, although in many instances we have carried it ahead of the exhaust pipe with equally good results; but in those cases, where it has been carried ahead of the exhaust pipe, it has been on those engines having a longer distance than usual from the center of the exhaust pipe to the flue sheet. In constructing these large passenger engines having long flues, we have built some with flues 19 feet long, and we have under contemplation some with even longer flues than that, which has been occasioned by the introduction of three pairs of large driving wheels and in some cases four-wheel trucks. In such cases, it is necessary to make the smoke-box as long as possible to reduce the length of the flues. In those cases we have put the diaphragm plate ahead of the exhaust pipe instead of back of it, and we have obtained some better results.

With regard to the forward portion of the front end, ahead of the exhaust pipe, it seems to be generally considered that a cylinder-valve is rather more a matter of ornament than use, and the majority of front ends are practically self-cleaning at the present time, if made short enough. Whether the cinder valve should be omitted or not, is a matter for the Association to decide.

Mr. David Brown (D., L. & W.)—What is good and serviceable for one kind of fuel may not be for another kind. The road with which I am connected up to within the last few years used nothing but anthracite fuel. With a pure anthracite coal we found that the arrangement for the front end of the Master Mechanics' Association was not as good as the arrangement we are using at this time. What new power we are getting is equipped with double nozzles and 18-in. straight stacks.

Mr. William McIntosh—I do not think it makes any particular difference whether the Master Mechanics' Association design of smokestack or nozzle is applied to an engine burning anthracite coal or bituminous coal. I think the results, so far as these particular parts are concerned, will be the same in either case. I am operating some locomotives with the Master Mechanics' design. We are burning hard coal and doing it very successfully. One of our most recent engines is fitted with that design almost exactly according to the recommendations. They are hard-coal burners, with rather small grate area, and are splendid steamers, so that as far as the design is concerned, I think it is as suitable for one class of fuel as well as the other.

Mr. Symington—The only difference between the modern engine, with large grates, and the old engines is in the volume of gases which have to go through the flues and be taken care of in the front end. The front end is designed to give as large a locomotive as possible, and we believe the Master Mechanics' arrangement is as good an arrangement as any we have had for large locomotives in the front end with the old-style engines. I ask Prof. Goss, judging from his experiments at Purdue, whether he believes any change in the proportion of the Master Mechanics' front-end design is necessary for taking care of larger quantities of gases.

Prof. W. F. M. Goss—Since I am down for the discussion of a subject touching this general question, which is to come up during the session on Wednesday, I have been slow to participate to-day. In answer to the question, I should say that no change would be necessary. The purpose of the front end is, as has been said, to bring the gases through the fire and tubes, and the fact that some change may be made in conditions at the other end of the tubes does not, it seems to me, affect the efficiency of the front end arrangement. If the grate is enlarged, or if the character of the fuel is changed, the character of the work to be done by the front end is not changed, and that arrangement of front end which is most efficient under one set of conditions at the grate is likely, it seems to me, to be equally efficient under another set of conditions at the grate.

Mr. David Brown—As regards the diaphragm, we seldom use a diaphragn or draft pipe. We have a plate from the top of the flues down to a line with the netting, on the bottom of the netting, which is between the exhaust pipe and the tip; the netting goes between the joint and has room enough not to interfere with the joint. That is the only diaphragm we have. We have no draught pipe whatever and have good steamers. Occasionally when we might want to make some little change we would put a short diaphragm in front of the exhaust pipe. The reason we put it in front is that we consider it easier on the steam pipes and the back of the exhaust pipe.

Mr. F. H. Clark (C., B. & Q.)—We have a number of engines with the wide fire-box and long tubes, and our experience corroborates Prof. Goss's idea that no change is necessary in the general arrangement of the front end for engines with such fire-boxes. We are using a smoke arch very similar to that recommended in the experiments made by the committee of the Master Mechanics' Association a number of years ago, although we are not using the petticoat pipe and in some other particulars have a slightly different arrangement. We find, however, that a similar arrangement that works well with the engines having narrow fire-boxes works equally well with the wide fire-box engines.

Mr. E. W. Pratt (C. & N. W.)—On the Chicago & North Western we have several engines with the wide fire-box with practically the same front end arrangement; that is, as regards the nozzles and stack, quite similar to the recommended practice of this association, and they have given satisfactory service. Touching upon the point that was made by Mr. Player as to the cleaning of the front ends, I think I may relate the result of an inspection made on the fuel of engines on the one thousand or more engines of our system. It was found almost without exception that these locomotives that cleaned their front ends and practically dropped no cinders from the hopper valve, whenever that was opened, very seldom had any trouble with burned front ends, while the opposite was almost invariably true of engines which did not clean themselves. In order to have this cleaning process take place on some of the locomotives that were burning up badly, the netting back of the exhaust pipe had to be entirely overhauled in many cases and the diaphragms lowered. In some cases a double diaphragm was employed. That was found to clean the front ends of these engines that were giving trouble, and did away with their burning.

Mr. Quereau—I have had some experience in the last few years with a self-cleaning front-end design, and I would say that it is entirely feasible and practicable. It remedies the burning out of front ends, and with the design of which I am speaking there were less sparks thrown out from the front end than with any other. The design was such as to break the cinders up. The experiences with these engines led me to believe that as the result of experiments that front ends can be designed without any diaphragm, movable or fixed. On these locomotives to which I refer, the fixed baffle plate was perforated with a number of holes. The results were satisfactory and there was no interference with the draught in the fire-box, and what was more important the distribution of the draft in the flues. I am satisfied that with most locomotives, with the present arrangement of baffle plates, much of the work is done in the lower half of the flues, because the flues above do not receive an equal portion of the draught and hence of the heat. On the locomotives of which I am speaking, the flues failed very much more uniformly than they used to do. The usual results in service are that from 75 to 125 of the flues in the bottom of the flue sheet failed before the balance failed and had to be renewed. With the locomotives in which the draught is more uniformly distributed, the failure was more uniform and the average life of the flues considerably longer. I agree with Prof. Goss that when we once have the most efficient end arrangement, it will be the most efficient regardless of fuel, size of locomotives, altitudes or country in which it is designed. In other words, the function of the front end is to produce a given draught through the flues with the least expenditure of power of the locomotive. When we have once obtained that, it should remain good for all conditions back of the front end. It is quite likely that it will be a matter of proportions rather than a matter of exact measurements; that is, if the proportions to a smaller boiler are followed out in the larger boiler, rather than the exact measurements, we will still have the most efficient front end.

Prof. H. Wade (Cornell Univ.)—There is an intimate connection between the diaphragm plate and brick arch and the wider present fire-box; the wider fire-box being typical of the present day construction of locomotive boilers. It would seem to me that if a diaphragm plate causes a greater draught at the front end to go through the lower tubes, there would naturally be a need for the brick arch at the rear end of these tubes to counterbalance that and make more of the draft at back end start in at the upper tubes. There are a number of reasons besides this, I believe, why a brick arch may be advisable, among them being the protection of the tubes from cold currents from the open doors, the flywheel action giving uniform fire-box temperature, higher fire-box temperature because of deferred contact of burning gases and cold steel, the commingling of the gases and oxygen in the fire-box, more complete ignition of all gases and fine carbon. One of the reasons for the brick arch would be the prevention of too rapid combustion at the front end of the grate area, causing holes in the fire and gases and excess air to go up directly from the grate to the lower tubes. The wide fire-box gives you an opportunity, provided you do not have any greater number of square feet of grate area than with a narrow fire-box, to have a shorter fire-box. I believe we have reached the limit of size of grate area with a narrow fire-box, because we have found that our firemen could not properly put the fuel in at the front end of the long grate area, and since he is not able to put the fuel in properly at the front end of that long grate, the fire-brick arch is advisable to protect the tubes and to prevent the gases and cold air through the holes in the fire getting directly to the tubes. With that same area of grate and the wide fire-box, I think the average fireman is able to pitch his coal better and so properly to cover the grate at the front end of the wide fire-box. Perhaps the development may be that with a wider, shorter fire-box we could entirely omit the brick arch and thus, in turn, entirely omit the diaphragm plate and still be enabled to get a proper passage of gases through both the upper sections of tubes and the lower sections of tubes.

Mr. Player—With regard to the matter of the diaphragm plate that Prof. Goss touched on, the object of moving the flue sheet further back from the exhaust pipe in our practice was to distribute the draught better upon these larger engines. I fully agree with Prof. Goss that the elimination of the diaphragm plate can be effected; and I would recommend that a committee be appointed to further investigate the proper dimensions for a standard front end and also to experiment upon the elimination of the cinder valve and to experiment in the direction of the elimination of the diaphragm.

Mr. Quereau—I would offer a suggestion and that is that work is being done now along that line in charge of Prof. Goss, by one of our railroad papers. Our president suggested that our Association could do no better than to substantially help in forwarding that work; and it occurs to me that we should pass a motion that our Executive Committee be authorized to assist in the work now being conducted at Purdue University along these lines. I will make a motion to that effect.

The motion was carried and the meeting adjourned.

Tuesday's Session.

The convention was called to order by President Waitt at 9 a.m. The first business was the report on "Up-to-Date Roundhouses," presented by Mr. David Van Alstine (C. G. W.)

UP-TO-DATE ROUNDHOUSES.

[*See the Railroad Gazette, June 27, page 489.*]

Mr. Quereau—I notice Mr. Quayle recommends an ash-pit with but one track. I am very strongly in favor of the clinker pit with two tracks with a depressed track for cinder cars between the two tracks. It takes from 12 to 18 minutes on an average to take care of the locomotive at a clinker pit. During the busy season, particularly at points where more than one district centers, it frequently occurs a number of times a day that there

(*Continued on page 533.*)

Recording Waybill Statistics by Machinery.

In the United States Census of 1890 it was demonstrated that statistical facts relating to a person or a farm could be transcribed to a punched record card and that these facts could then, with great economy of time and labor, be tabulated by means of mechanical devices producing any desired statistical result. This led to the suggestion that a punched record card be used in a railroad auditor's office, in place of a written transcript, to preserve the facts pertaining to a waybill.

This fundamental idea was presented to the officials of the New York Central & Hudson River, and after a number of years of experiments a system was finally developed which it is believed may have far-reaching results on the method of auditing freight accounts and compiling statistics relating to freight traffic.

In establishing the new methods the company adopted, as the primary record for the general office a daily agent's forwarded and received report. This was adopted because, so far as the work of the auditor's office is concerned, such a daily report lends itself as readily to mechanical treatment as a monthly report, and a daily report possesses advantages to the agent.

1. In entering his waybills he simply enters them as they come in, and does not, in addition, have to find the place where they are to be entered.

2. In getting his totals for the month he simply adds 25 daily totals, whereas in a monthly system he must develop his waybill items by as many totals as there are station-to-station groups in his billing.

3. He is able to know as soon as the last bill is entered on his received register, just the exact amount of the debit against his station from this source. In the other case he does not know until the end of the month; or, if he wishes to know daily, he must multiply his station-to-station totals by 25 (approximately) to develop them by days in order to balance daily.

state business, whether billed from a local or a foreign point, and, finally, whether billed to a local or a foreign point.

It will be noticed that there are two X's corresponding with the fields for advances and prepaid. The X key is so arranged that punching the hole X in either of these fields is equivalent to stating that the corresponding column was blank on the waybill, and the card will move four rows to the next field.

Besides the key punch just described a "gang" punch is used for punching, in the first three columns at the left-hand end of the card, the month and the date of the received report to which the card refers. This gang punch is arranged so that the punches are set to correspond with the given month and day, and as many as ten or fifteen cards can be punched at one operation. For the larger and more important stations the symbols

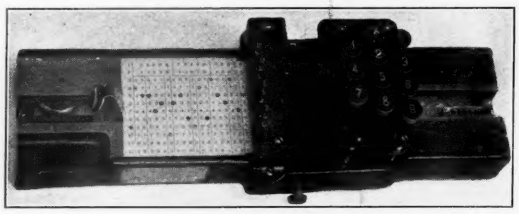


Fig. 1.—Card Punch.

designating the received stations are also punched in the gang punch, the key punch being arranged in these cases to begin punching in the seventh instead of the fourth row. The idea of the gang punch is simply to substitute it for the key punch, where a large number of cards are to be punched for the same facts.

In addition to the punching of the cards just described, there are three fields, each numbered from 0 to 9, across

crepancy, the cards are checked, one by one, until the discrepancy is accounted for and the proper correction made on the card.

As soon as the reports and the punched transcripts have been verified in this way, the cards are sorted according to forwarding stations and date forwarded, and properly filed in suitable cases. After a certain length of time, long enough to get all the bills in, the cards corresponding to the first day's forwarding are tabulated in the tabulating machine, and the total so obtained for each station is compared with the agents' forwarded reports. If the machine total agrees with the total of the agent's report, it shows that every waybill reported forwarded on that report has been properly taken up by the receiving agent. In the case of discrepancy in these totals the cards are arranged in numerical order, according to the number of the waybill, and the amounts checked, bill by bill, until the discrepancy is accounted for. Sometimes such discrepancies are due to difference between the amounts recorded on the cards, or, in other words, the amount reported by the receiving agent, and the amount reported by the forwarding agent. In such cases these discrepancies are noted on a so-called "difference sheet," and, according to the decision of the auditor, either the received or the forwarded report is changed accordingly; the card in the meantime being changed, if necessary, by covering the punched holes with little pieces of courtplaster and punching the correct amounts, the pieces of courtplaster corresponding to red ink. Should the discrepancy be due to the fact that a card is found which is not on the forwarded reports, such card is laid aside and marked as "not found" on the particular day; or if a waybill is reported on the forwarded report for which no corresponding card is found, a note of such missing card is also made on an "on and off" sheet. It frequently happens, of course, that the receiving agent reports the wrong date forwarded, which is usually detected by the number of the waybill, and

Fig. 3.—Hollerith Electric Tabulating Machine.

Fig. 4.—Side View of Tabulating Machine.
A, radial arm; M, magnets.

In the auditor's office, we start with the daily received report, one from each station. These reports are given to clerks who transfer day by day the facts concerning each waybill, as found in the received report, by means of a simple little machine illustrated in Fig. 1, to a card printed as shown in Fig. 2.

The punching machine, Fig. 1, is provided with ten punches, each operated by one of the keys numbered from 0 to 9, and an additional punch and key marked X, the purpose of which will be explained later. The card is inserted in the punch by the operator until the fourth vertical printed row from the left is directly under the punches. The clerk has, for example, the received reports for a given station, the symbol for which might be 123. The key 1 is depressed, which punches a hole in line 1 of the fourth vertical row. Upon the release of this key the machine feeds the card forward to the next vertical row. The operator then strikes key 2, punching a hole in line 2 of the fifth row. The card again feeds forward, and the operator strikes key 3. By thus striking in succession the keys 1, 2 and 3 the number 123, being the designation of the given received station, is recorded in these three rows. The next items recorded on the cards are the line (or road) by which forwarded, the number corresponding to the forwarding station, the via point, the date forwarded, then the three terminal figures of the number of the waybill, then the commodity, the weight, the freight, the advances and the amount prepaid. The small fields at the extreme right of the card are used to record whether the waybill originated on or off the road, whether it is State or Inter-

the top, which are used in connection with a gang punch, for punching the miles corresponding to the movement of the freight represented by the given card. The points E and W are punched to indicate whether the card represents a movement east or west.

From this description of the operation of punching, the reader may perhaps infer that this work is slow. As a matter of fact, however, clerks can make records of waybills by punching much more rapidly than by writing with a pen. A sample record is given below.

As soon as the items for a given received report have been transferred to punched cards, the cards are passed through a tabulating machine, illustrated in Fig. 3 This machine is so arranged that when the card is laid on the bed plate and the handle depressed, each register (adding machine) operates to indicate an amount corresponding to the amounts recorded by the punched holes in such card. After a number of cards have in this manner been successively run through the machine the registers will show the sum total of such cards. In short, it is an adding machine in which 17 columns of figures, represented on the cards by punched holes, are added, and this can be done, according to the skill of the operator, at a speed of from 45 to 60 cards a minute. When, therefore, the cards corresponding to the items on a given day's report from a given station are run through the tabulating machine, if the sum total shown on the machine agrees with the totals, as written by the agent at the foot of his report it proves that the transcript to punched cards has been accurately made; and also that the agent's additions are correct. In case there is a dis-

when the waybill to which the card refers is located the date is changed accordingly and the card put in its proper place. The checking in this way commences a few days after the first of the month and is kept up until the business for the month has been properly checked. The cards are then all corrected, and the corrections are made on the reports.

The cards are now run through the machine to obtain the total month's business for each forwarding station, and for the larger stations the total is noted for each day's business. If all the corrections have been properly made the total so obtained from the cards must tally with the corrected agent's forwarded reports. The cards are then sorted according to the received stations, and subdivided according to stations from which forwarded, and in these station-to-station groups the cards are run through the machine; thus obtaining a total for the business done between any two points during the month and giving what are known in the office as "monthly summaries." In this way we also obtain the total of the business received at each station during the month, thus checking the corrections on the agents' received reports. From this summary the ton-mileage is obtained.

It will be noticed that we have individual cards, each representing one waybill; and these cards can be shifted rapidly from one grouping or arrangement to another, and can be rapidly added to obtain the different desired results.

In sorting the cards the only implement used is a knitting needle. Often a considerable number of cards can be lifted off at one time, the corresponding hole be-

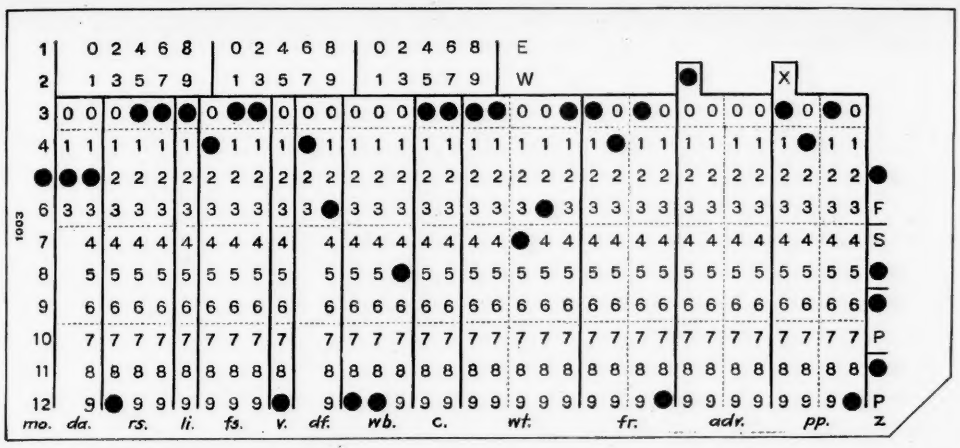


Fig. 2.—New York Central Traffic Card. (Three-fourths the actual size.)

Note.—The letters at the bottom do not appear on the card, but were added by the engraver. They mean, in their order, month, day, receiving station, line, forwarding station, via, date forwarded, way bill number, commodity, weight, freight, advanced charges, prepaid.

ing punched through all such cards. The sorting can be done rapidly because no particular care need be taken; for after the cards have been sorted, the correctness of the sort can be determined by simply aligning the cards, when the corresponding hole should appear through all the cards. This can be tested with a knitting needle or else by holding up a bunch of cards and looking through the proper hole.

To illustrate the possibilities of the use of a punched card of this kind, if we have punched in the card (1) the number of miles corresponding to the movement of the waybill and (2) the commodity, it becomes a very simple matter to obtain the earnings per ton per mile for the different commodities; for it is only necessary to sort the cards according to commodities, subdivided according to mileage, and tabulate accordingly. This tabulation could then be done entirely irrespective of the points of origin and destination. Again, if it is desired to know the earnings per ton mile on long hauls, as compared with short hauls, this information is at hand by simply arranging the cards according to miles. The cards, if desired, can also be sorted according to waybills, the earnings of which were between certain limits. We can obtain the earnings per ton per mile on waybills originating in certain territory or destined to certain territory.

In fact, any desired information can be obtained from these cards that is shown by the data on the card.

In the foregoing we have treated the waybill as the unit. If a given waybill contains a number of commodities, and the commodities are to be recorded, then supplemental cards are to be used for such commodities.

An agent's daily report does not contain a full transcript of each item on every waybill; he lumps items together, as far as this may properly be done without interfering with the demands of the auditor's record.

Corrections of computations are made in another office, from tissue copies furnished by the forwarding agent.

The facility acquired in transferring the records on waybills to punched cards is shown in the table herewith, which represents the work of the clerks on punching machines at the New York Central office, in New York City, during five days, with the number of hours worked each day and the number of cards punched or waybills transcribed during such time. A column is also given to show how long the clerks have been engaged in this particular work.

This record shows that for a uniform day of 7¼ hours the average for the entire force is 1,358 cards per clerk. The records for clerks A and K are considerably below the average, and if their records were omitted the average would be 1,448 cards per clerk per day. It is to be noted that clerk A had been engaged in this work only one month. A record of work done by this same clerk in the five days ending June 20, shows an average of 1,370 per day of 8¼ hours, as compared with an average of 960 for a day of the same length in April. This affords an illustration of the short length of time necessary to acquire a fair degree of efficiency.

Fig. 2 represents a card in which has been punched the transcript of a waybill which was received May 22 at Boston. There was no "line." It was forwarded from Barclay street, and therefore was joint business, and was forwarded on the 13th. The last three figures of the waybill number were 995. Thousands and tens of thousands of the waybill numbers are ignored because the business of any one station does not run beyond a thousand waybills in a day. The commodity was 00, or merchandise. The weight was 430 lbs.; the freight on this shipment was $1.09. There were no advanced charges, and the amount prepaid was $1.09.

The letters at the extreme right of the card are, reading down, L, F, S, IS, L, P, L, P, meaning, respectively: Local, bill originating on the line of the road; Foreign, received from foreign road; State business; Interstate business; reported on local forwarded reports; reported on passing forwarded reports; reported

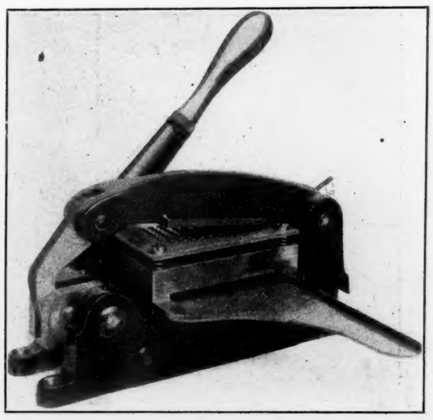


Fig. 5.—Gang Punch.

on local received reports; reported on passing received reports. This waybill originated on the line of the road, was interstate business, was reported on a local forwarding report and was also reported on a local received report.

Up to the present time the commodities have not been punched by the New York Central, but the card is arranged so that it can be done whenever desired. The three spaces or fields at the top of the card for punching mileage are not used at present. The intention is, however, to punch in these spaces the number of miles, with a gang punch, as well as the direction of motion, whether east or west, after the cards have been sorted to station-to-station groups. The mileage being punched in this way will facilitate the compilation of all statistics relating to ton miles, and will make possible the classification of the business according to long and short hauls, etc.

The mechanical details of the machine can be understood by an inspection of Figs. 3 and 4.

The punched card is 7⅜ inches long and 3¼ inches wide. It stands between the agent's reports and the tabulating machine, and is the means by which the tabulating machine is made to mechanically discriminate in classifying the data borne by the card into groups, classes or categories. By the special location of a hole within the limits of certain boundary lines on the card it means one thing, and in another position it means another thing. The card having been punched with holes to signify by their positions on the card the information contained on the written agent's reports, the said card is put into the tabulating machine, where it acts as a stop diaphragm between a multiplicity of little spring-seated pins above the card and a corresponding series of mercury cups below the card. The pins are now, in a group, brought down, and those which are in line with holes in the card will descend through said holes and by touching the mercury below, will close so many separate electric circuits. Those pins which do not find holes in the card below them do not pass to contact with the mercury and do not close their individual electric circuits. Each pin and its mercury cup are terminals of a separate electric circuit passing through an electro-magnet controlling a counter or register. The pins are carried in a frame known as a pin-box. It will thus be seen that the so-called pin-box is a sort of electric permutation circuit controller, and that the circuit closed through any one counter or register will be determined by one position of a hole in a card, and another circuit through another counter by another position of a hole. This gives the machine a mechanical selective action and constitutes its mode of thinking, as it were. It is not practicable within the limits of space available to describe in detail the tabulating and adding devices. It must suffice to say that a punched card is placed below the pin-box on the subjacent table surface bearing the mercury cups shown on the right of Fig. 3, and the pin-box being brought down by the operator by means of the handle bar, the card automatically selects its counters or adding wheels as hereinafter described. To explain how the machine adds, i. e., how a group of units is at one operation transferred to the adding wheel, reference is made to the rear view. For each adding device there is a series of nine electro-magnets arranged in an arc about the adding wheels. A radial arm oscillates or swings about the center of the adding wheels, and in its sweep a pawl carried by it is made to turn the adding wheels any number of spaces according to the number to be added. This is accomplished by causing the turning pawl of the swing arm to act on the adding wheel sooner or later in the sweep of the arm. If it acts immediately on starting it turns the adding wheel nine spaces and adds 9. If it does not act until it has passed the fifth magnet it turns the wheel four spaces and adds 4. The timing of the action of the pawl on the adding wheel as the arm sweeps over the same is effected by the segmental series of the electro-magnets as follows: Each magnet is connected to the electrodes of the pin-box, and the selection of a particular magnet in the curved series is controlled by the selective action of the punched card at the pin box, which is made to close a circuit through any one of the magnets of the curved segment. Such magnet when energized is made to release a trip pawl that is thrown into the path of the swinging arm and, striking an attachment thereon, causes the turning pawl of the swinging arm to engage an adding wheel and turn it a greater or less number of spaces according to the position of the magnet in the segmental series which has been energized.

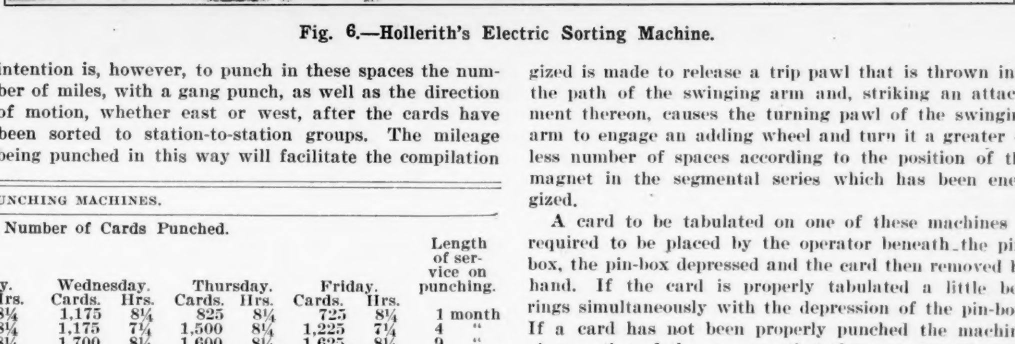


Fig. 6.—Hollerith's Electric Sorting Machine.

A card to be tabulated on one of these machines is required to be placed by the operator beneath the pin-box, the pin-box depressed and the card then removed by hand. If the card is properly tabulated a little bell rings simultaneously with the depression of the pin-box. If a card has not been properly punched the machine gives notice of the same so that the error may be corrected.

The little box which is seen in front of the machine, Fig. 3, beside the lamp, has the function of a controlling switchboard. In running for summaries, the pins are set, for example, to represent cards corresponding to movement of freight from Buffalo to Weehawken, or say from station 126 to station 673. As long as cards cor-

RECORDS OF WORK ON PUNCHING MACHINES.

Number of Cards Punched.

Clerk.	Monday. Cards.	Monday. Hrs.	Tuesday. Cards.	Tuesday. Hrs.	Wednesday. Cards.	Wednesday. Hrs.	Thursday. Cards.	Thursday. Hrs.	Friday. Cards.	Friday. Hrs.	Length of service on punching.
A	825	8¼	1,250	8¼	1,175	8¼	825	8¼	725	8¼	1 month
B	1,250	7¼	1,475	8¼	1,175	7¼	1,500	8¼	1,225	7¼	4 "
C	1,550	8¼	1,850	8¼	1,700	8¼	1,600	8¼	1,625	8¼	9 "
D	1,850	8¼	1,250	8¼	1,050	8¼	1,750	8¼	1,550	8¼	9 "
E	1,500	8¼	1,025	8¼	1,225	8¼	1,700	8¼	1,750	8¼	12 "
F	1,125	8¼	1,450	8¼	1,275	8¼	1,250	8¼	1,275	8¼	3 "
G	1,650	8¼	1,850	8¼	1,825	8¼	1,850	8¼	1,875	8¼	12 "
H	2,200	8¼	2,350	8¼	2,350	8¼	2,100	8¼	2,425	8¼	3 "
I	1,475	8¼	900	8¼	1,150	8¼	1,500	8¼	1,225	8¼	9. "
K	.....	...	.....	...	400	8¼	absent.		600	8¼	2 "
L	1,475	8¼	1,350	8¼	1,500	8¼	1,475	8¼	1,575	8¼	1 "
M	2,175	7¼	2,325	7¼	2,350	7¼	2,025	7¼	1,875	7¼	12 "
Totals	17,075		17,075		17,175		17,575		17,725		

responding to these forwarding and receiving stations are placed in the tabulating machine the machine will operate. If, however, a card representing any other forwarding or receiving station should be placed in the machine, the machine will not operate, but the light will flash, indicating to the operator that the end of that group of stations has been reached, that a reading should be taken, the machine set to zero by pulling down the handles and the plugboard or switchboard set to the next receiving station.

In order to facilitate the sorting of cards into groups, use is made of an automatic sorting machine, illustrated in Fig. 6. A stack, c, of four or five hundred cards may be placed in this machine, and the small electric motor, m, started. The cards are fed singly into one of 10 tracks, these tracks ending over 10 receptacles, so that each card is deposited in a compartment according to the hole punched in the given row according to which the cards are being sorted. It is a simple matter to change this machine to sort different columns, and as one operator can attend to a number of these machines, the cost of sorting is reduced to a minimum.

The latest development of this system is the automatice tabulating machine, in which the work of separately placing each card beneath the pin-box, depressing the pin-box, and removing the card, is performed automatically by a machine instead of by hand. This automatic machine is operated by an electric motor supplied by current from the cable overhead. The cards are fed in a bunch to the top of the machine, the pin-box occupies a vertical instead of a horizontal plane, and the mercury cups are replaced by spring jacks. The machine itself successively feeds each card to the pin-box or circuit controller and tabulates its data automatically. If an improperly punched or distorted card happens to be in the lot it is automatically thrown out into a special receptacle for it, while the properly registered cards go to their own compartments.

Car Accountants' Convention.

The Twenty-seventh Annual Convention of the International Association of Car Accountants and Car Service Officers was held at Milwaukee, June 23 and 24, with a good attendance. The principal discussion was on the application of the Per Diem Method of Settlement for Car Hire from July 1. The Rules were taken up seriatim, and there was a general discussion as to the understanding of representatives present as to the methods of applying the Rules.

Under the second section of Rule 2, the inquiry was made as to whether or not the literal application of this section would mean that where a car was received and delivered the same day, the owner did not receive Per Diem for that day. This inquiry was answered by calling attention to the fact that payment is made by the road having possession of the car at 12:01 midnight, that therefore there would be 365 days Per Diem paid for a car off the home road during the entire year.

On Rule 3 an extended discussion was entered into as to whether or not the penalty rate would be required on all foreign cars held 30 days and over. Several representatives stated that they would demand penalty rate on all cars detained, but the general opinion expressed was that this rule would not be applied drastically; it would be used only in cases of emergency.

In considering the application of Rules 4 and 5, representatives reported local meetings at various points throughout the country to determine the reclaim days that would be allowed switching roads on switched cars. It appears that the usual practice at large centers will be to authorize during the first three months, as an experiment, a reclaim of four days on all cars switched for loading and unloading, and a reclaim of one day on "transit cars" handled from one railroad to another. There are some exceptions. In Chicago five days reclaim will be allowed on cars switched for loading and unloading. The general practice during the first three months will be to allow a reclaim of four days. Under these rules the question arose as to whether or not reclaim should be allowed on a car handled in switched service by the owning road from a connection. To provide a uniform understanding a resolution was passed to the effect that reclaims should not be allowed on cars switched by owners nor upon private cars.

In considering Rule 7, a resolution was passed stating the understanding to be that where cars are en route home on cards on account of being unfit for service and that when cars are en route to owners from manufacturers, no Per Diem should be paid.

In connection with Rule 9, the form of interchange report suggested at the Conference at Cincinnati was discussed favorably, but it was deemed inexpedient to recommend any definite form for universal adoption because local conditions will necessitate variations.

Consideration of Rule 10 brought up the oft recurring and vexing subject of delay in receipt of junction cards. Inasmuch as the junction card will now be the basis for accurate accounting, and promptness is important, a resolution was passed recommending all roads to make these reports invariably upon United States postal cards.

The subject of reclaims was fully discussed; and it appeared to be the sense of the meeting that the basis for settlement of reclaims on switched cars must of necessity be the report of the local agent.

The latter part of the session of Tuesday was devoted to considering blanks presented by the committee appointed at the Conference in Cincinnati, consisting of Messrs. Aylesbury, Riley and Cannon.

The election of officers resulted as follows: G. H. Waldo, President; W. H. Rosevear, Vice-President; L. G. Corcoran, Secretary; F. M. Luce, Treasurer.

A committee on Per Diem was appointed, consisting of C. C. Riley, Chairman; H. L. Hunter and T. F. Brennan. The next annual meeting will be held at Quebec, June 16, 1903.

John Butler Johnson.

It is a sad duty to have to record the untimely death of John Butler Johnson. It is a great loss personally, a great loss to the engineering profession and to the important branch of that profession which is teaching young engineers, and the loss is greatest of all to the young men who are preparing to enter the profession. Mr. Johnson was killed in a runaway accident at his summer home at Pier Cove, on the east shore of Lake Michigan. This occurred on Monday, June 23.

Mr. Johnson was born of Quaker parentage, on a farm near Marlboro, Ohio, June 11, 1850. He had a good preliminary education, and, as is so often the case with the ambitious youth of the country, he sharpened his own faculties by teaching country schools, and became a high school principal. In 1872 he was the Secretary of the Indiana School Board, so we see he came naturally by that zeal and efficiency as a teacher which he displayed all of his life. He entered the University of Michigan in 1874, being then 24 years old, and was graduated in 1878. For the next five years he practiced as a civil engineer and then was called to the chair of civil engineering at Washington University, at St. Louis, Mo.,

John Butler Johnson.

where he remained 16 years. In January, 1899, he was appointed Dean of the College of Engineering of the University of Wisconsin, and this position he held at the time of his death. This is a short outline of his professional work, but along with it went constant work as an author.

He had published four important books. The first of these was "The Theory and Practice of Surveying," which was published in 1886, and which has passed through a dozen editions and frequent revisions, and which is still largely sold. This was Mr. Johnson's first complete text book and he was compelled to write it because he found no text book that suited him for work in his own classes. The book was prepared primarily for his own use. In 1892 he wrote the "Theory and Practice of Modern Framed Structures," which has also been a successful book, if we may judge from its reputation and large sale. In the preparation of this book he was assisted by Prof. F. E. Turneaure and Mr. C. W. Bryan. He had in preparation an important addition to this book relating to steel concrete construction. Another important book was "The Materials of Construction," which is rather a reference book than a text book, and as such it fills an important place. His last book was "Engineering Contracts and Specifications," and this book has been received with great favor by the profession. Beyond the preparation of these important books Mr. Johnson contributed many articles to engineering journals and other publications, and to the Transactions of the numerous societies to which he belonged, and he delivered many addresses and was always willing to take part in public discussion of scientific questions. This is a summary of what may be called the literary side of his life, although it is inadequate for it does no more than suggest the range of his intellectual activity. He was a member of the American Society of Civil Engineers, the Institution of Civil Engineers of Great Britain, the Western Society of Engineers, and Fellow of the American Association for the Advancement of Science and a member of numerous other societies and clubs. He was also a member of the committee on the proposed Carnegie Institute at Pittsburgh.

Beyond the activities suggested by what has been written above, Mr. Johnson was deeply interested in the work of the Unitarian Church and was a Trustee of that Church in Madison and Superintendent of the Sunday school. He was a life member of the Unitarian Conference. Still further, he was a man of fine taste in literature, was interested in the study of poetry especially and was practically the founder of the Art Club in Madison.

Mr. Johnson's private life was beautiful. He was a man of the simplest tastes and was devoted to his family and to his friends. His summer home was especially chosen for its quietness and remoteness and there he had gathered about him a little group of congenial people. And in that peaceful home, which could hardly be associated with danger, he met his sudden death.

Professor Johnson's great work was as a teacher and when we say this we do not mean to imply that his work as an author and an engineer had not been important, for it had been important; but his whole make-up, intellectual, spiritual and moral, was designed to make a teacher. He loved nothing else so well as the discovery of knowledge, unless it may have been to impart it. His genial and sympathetic soul won the confidence and affection of his students and his fiery energy and perfect courage were to them an inspiration. It is probably true that no other man at the great University of Wisconsin was so close to so many of the students as was Johnson, and he had especially designed his work with a view to getting into personal contact with the greatest possible number of the undergraduates. He was a thoroughly modern teacher and with his instinctive love for science was closely associated a sound and enterprising practical sense and he was constantly looking forward to modifying the courses in the engineering schools with a view to making more useful men of his students.

It is a dreadful thing to have to record the death of such a man while still so young and strong. He had already accomplished enough to satisfy most of us and yet, so far as we can judge, he had just reached the point of his greatest usefulness and efficiency. It is not unreasonable to suppose that in the next 15 or 20 years he would have done vastly more for his profession and for his country than he had done up to the time of his death, great as his services have been.

Train Accidents in the United States in May.†

rc, 1st, 2 a.m., Pennsylvania road, Rahway, N. J., rear collision of freight trains, wrecking 10 cars. A brakeman was killed.

dn, 1st, Cincinnati, Lebanon & Northern, Winslow Park, Ohio, a gravel train was derailed at a misplaced switch and the engine was overturned. Three employees were injured.

unf, 1st, 5 a.m., Mexican National, Benavides, Texas, a freight train broke through a bridge which had been weakened by fire, and the engine and several cars were wrecked. The engineman and fireman were badly injured.

xc, 2nd, New York Central & Hudson River, Clyde, N. Y., collision between westbound fast mail train No. 3 and an eastbound freight which was crossing from one main track to another. Both engines, one mail car and six freight cars were wrecked. One engineman and one fireman were killed, and 13 mail clerks were injured. The mail train was running at high speed. It is said that the men in charge of the freight wrongfully assumed that the block signal operator was protecting their movement.

xc, 3rd, Chicago & Alton, Joliet, Ill., collision between a passenger train and a switching engine, overturning the passenger engine. Two cars were wrecked; one passenger was injured.

†bc, 4th, Baltimore & Ohio, Rockwood, Pa., butting collision between a westbound passenger train and an eastbound freight, both running at good speed. The passenger train consisted of 10 cars, occupied by Italian emigrants. The baggage car, three of the passenger cars and a number of freight cars were wrecked. Two passengers were killed and 16 passengers and one employee were injured. The passenger train was the second section of No. 47; the freight met the first section all right, but the second was "overlooked."

unx, 4th, Pittsburgh, Ft. Wayne & Chicago, Rochester, Pa., the engine of a passenger train, carrying workmen employed by the road, was derailed and overturned, blocking all four main tracks. The engineman and fireman were fatally scalded. The engine was at the rear of the train, and the single passenger car was not derailed.

*o, 5th, 3 a.m., Detroit Southern, Cairo, Ohio, a freight train was set on fire by the explosion of naphtha with which one of the cars was loaded, and three cars of oil and seven of merchandise were burned up. A brakeman was fatally injured.

xc, 5th, 8 p.m., Louisville & Nashville, Henderson, Ky., collision of freight trains, switching in the yard, wrecking five cars. The fireman and one other employee in a bridge gang who were in one of the cars, were fatally injured.

*unf, 6th, Atchison, Topeka & Santa Fe, Flagstaff, Ariz., a passenger train broke through a bridge which had been weakened by fire, and the dining car, two sleeping cars, and one other car were destroyed by fire. One trainman was injured.

rc, 6th, 10 p.m., St. Louis & San Francisco, Lancaster, Ark., a freight train ran into the rear of a preceding freight, which had stopped to take water, and the caboose and three freight cars were wrecked. A man sleeping in the caboose was killed.

*dn, 6th, 9 p.m., Colorado Midland, Arkansas Junction, Col., 13 cars of a freight train left standing on a grade without an engine, and without having brakes properly set, broke away and ran back down hill 22 miles. The

†Accidents in which injuries are few or slight and the money loss is apparently small, will as a rule be omitted from this list. The tabular record of totals is no longer kept, as a more complete report of the total number of accidents is published by the Interstate Commerce Commission. The classification of the accidents is indicated by the use of the following

ABBREVIATIONS.

rc	Rear collisions.
bc	Butting collisions.
xc	Miscellaneous collisions.
dr	Derailments; defect of roadway.
eq	Derailments; defect of equipment.
unf	Derailments; unforeseen obstruction.
unx	Derailments; unexplained.
o	Miscellaneous accidents.

An asterisk at the beginning of a paragraph indicates a wreck wholly or partly destroyed by fire; a dagger indicates an accident causing the death of one or more passengers.

whole of them were derailed at milepost 109, and the wreck, which took fire from the stove in the overturned caboose, was destroyed by fire.

†rc, 7th, 4 a.m., Union Pacific, North Topeka, Kan., an eastbound freight train which had stopped at a crossing, was run into at the rear by a following freight, and the caboose and three cars were wrecked. Two drovers, riding in the caboose, were killed, and seven others were injured. There was a dense fog at the time.

*rc, 7th, 5 a.m., Southern Railway, Lawyers Road, Va., passenger train No. 37 ran into rear of preceding freight train, badly damaging several cars. Two passenger and two postal cars were wrecked and destroyed by fire. The engineman and fireman jumped off and were slightly injured. The freight had taken a siding for three passenger trains to pass, and to meet two trains in the opposite direction. After two trains had passed and the two in the opposite direction had also passed the waiting train pulled out of the siding and was struck by No. 37.

7th, Atchison, Topeka & Santa Fe, Miller, Cal., several cars in a passenger train were derailed and eight passengers were injured. It is said that the derailment was due to the automatic application of the air-brakes in consequence of the failure of a drawbar.

unx, 7th, Ohio Central, Toledo, Ohio, passenger train No. 23 was derailed and one passenger car was overturned. The 35 passengers in the train escaped with slight injuries.

*7th, 8 p.m., Chicago Great Western, Talmage, Iowa, a car in a freight train was derailed while crossing a bridge, and, with the car next behind it, broke through the bridge. Oil in a car took fire and the bridge and the wrecked cars were burned up. The conductor was killed.

dr, 8th, 1 a.m., Chicago & North Western, Ames, Iowa, fast mail train No. 10 was derailed and four cars were ditched. A tramp was killed and one mail clerk was injured. The train was running at high speed and the derailment appears to have been due to irregularities in the track, the roadbed being new.

*xc, 8th, 4 a.m., Pennsylvania road, Logan's Ferry, Pa., a freight train collided with some freight cars which had been left standing on the main track and several cars were wrecked. The wreck took fire from the locomotive and a large quantity of glass in one of the cars, being melted by the fire, spread over the ground for a considerable area around the wreck.

xc, 9th, Southern Railway, Wilmer's, Va., 15 cars of a freight train left standing on the main track ran away down grade, and, after running about four miles, collided with a work train, wrecking both engines and several cars. A brakeman jumped off and was killed. Before the collision the work train engine had been reversed and deserted, and it ran some distance and collided with another freight train, wrecking several cars.

*unx, 9th, Illinois Central, Memphis, Tenn., a mixed train was derailed by the breaking of the flange of one of the wheels of a freight car and several cars were ditched. The wreck caught fire from a pile of old sleepers, which was burning at the side of the track, and two passenger and three freight cars were burnt up. Two passengers were slightly injured.

xc, 10th, Chicago & North Western, Hortonville, Wis., collision of freight trains, wrecking several cars; one brakeman was killed.

*12th, 5 p.m., Pittsburgh, Cincinnati, Chicago & St. Louis, Sheridan, Pa., a tank car loaded with oil, while being switched in the yard, was damaged by a slight collision due to difficulty in controlling the speed of a part of a freight train, and the car was set afire, supposedly by a lighted switch lamp which ignited oil dripping from the broken car. The car exploded and spread fire around so rapidly that the trainmen were overpowered. About half an hour after the collision another tank car, containing gasoline, exploded with such violence that over 150 persons, most of them spectators, were injured, and 25 of these persons killed. The burning oil, flowing down toward the Ohio river, caused a fire and explosion, accompanied by injuries to many persons, at a point more than a mile from the place of the accident.

eq, 12th, Atchison, Topeka & Santa Fe, Revere, Mo., an eastbound passenger train was derailed by the breaking of an axle. Seven passenger cars were damaged; a freight car standing on a side track was wrecked. One passenger was injured.

unx, 12th, Louisville & Nashville, near Iron City, Tenn., a work train was derailed, and the caboose was overturned and fell down a bank. One man was killed and the conductor and two other employees were injured.

dn, 12th, 11 p.m., Gulf & Ship Island, Jackson, Miss., passenger train No. 4 was derailed at a misplaced switch, and the engine and baggage car were overturned. The engineman was killed and the fireman fatally injured. A man standing near the track was badly injured.

eq, 13th, 1 a.m., Chicago, Milwaukee & St. Paul, South Germantown, Wis., a car in a freight train was derailed by a drawbar, which was pulled out and fell to the track, and, with nine other cars, was wrecked. Three tramps were injured.

unx, 13th, Northern Pacific, Drummond, Mont., a car in a freight train was derailed, and one employee was killed.

dr, 13th, Chicago & Alton, Elwood, Ill., a passenger train was derailed at a defective switch, and four cars fell against a bank. One passenger was injured.

xc, 14th, Northern Pacific, Interbay, Wash., a freight train approaching the station at uncontrollable speed collided with a switching freight, wrecking one engine and several cars. One fireman was killed and two other trainmen were injured.

bc, 15th, Minneapolis, St. Paul & Sault Ste. Marie, Pembine, Wis., butting collision between a passenger train and a freight, wrecking both engines and several cars. One engineman was injured, probably fatally, and four other persons were hurt.

eq, 15th, Pennsylvania road, Marysville, Pa., a circus train was derailed by a broken truck, and six of the circus men were injured.

xc, 16th, West Virginia Central & Pittsburgh, Rosedale, W. Va., a work train, standing on a curve, was run into by a passenger train, and both engines, one passenger car, and several platform cars were damaged. The passenger fireman was fatally injured, and two other trainmen were hurt.

unx, 16th, Chicago, Rock Island & Pacific, Liberal, Kan., a freight train was derailed and seven cars were ditched; a brakeman was killed.

rc, 17th, 4 a.m., Pennsylvania road, Jersey Shore, Pa., a passenger train ran into the rear of a preceding freight, which was about to enter a side track; the passenger engineman was killed and the freight conductor was injured.

†bc, 17th, Chicago, Burlington & Quincy, Hyannis, Neb., butting collision between an eastbound passenger and a westbound freight train, wrecking several cars, including the smoking car of the passenger train. Four passengers and a fireman were killed and four passengers injured.

bc, 17th, Great Northern, Minot, N. Dak., butting collision between an eastbound passenger and a westbound freight train, damaging both engines. The freight engine, having been reversed and deserted, and having but a few cars attached, ran down grade about two miles unattended, where it collided with a part of its own train, which had been left there; three cars of cattle were crushed, and the animals killed. There was a dense fog at the time.

unf, 17th, Chicago Great Western, Almoral, Iowa, a freight train was derailed at a washout, and the engine and several cars were wrecked. The engineman and several trainmen were injured, the former fatally.

xc, 18th, Atlantic, Valdosta & Western, Crawford, Fla., a passenger train, the engine of which had been left unattended, was started in some way, apparently in consequence of a leaky throttle valve, and ran some distance to the crossing of the Sea Board Air Line, where it struck a passenger train of that road, overturning the engine and derailing two cars.

dr, 20th, St. Louis & San Francisco, Platter, Ind. T., a passenger train running slowly on account of soft spots in the track was derailed and three cars fell down a bank and were wrecked. The express messenger was injured.

unx, 20th, 1 a.m., Toledo, St. Louis & Western, Charleston, Ill., an eastbound passenger train was derailed and three cars were overturned. Eight passengers were injured.

eq, 21st, Grand Trunk, Mishawaka, Ind., a westbound passenger train running at high speed was derailed and seven cars were ditched. Six passengers and four trainmen were injured. The derailment is believed to have been due to a broken truck.

xc, 23rd, Pennsylvania road, Morrisville, Pa., collision of freight trains in the yard; one trainman killed and one injured.

xc, 23rd, Vicksburg, Shreveport & Pacific, Ruston, La., a freight car which had escaped control while being switched ran some distance down grade on the main line and collided with freight train No. 33, making a bad wreck. The engineman and fireman were injured, one of them fatally.

unx, 23rd, Union Pacific, Cayuga, Neb., a freight train was derailed and six cars were wrecked. Two tramps were killed.

rc, 24th, Northern Pacific, Heron, Mont., a freight train ran into the rear of a preceding work train, which was standing at a tank, wrecking the caboose. The engineman was killed and two other trainmen were injured.

bc, 25th, Ashley Junction, S. C., butting collision between engines of the Plant System and the Atlantic Coast Line, badly damaging both engines. Four trainmen were injured, one probably fatally.

eq, 25th, Union Pacific, Uintah, Utah, a freight train was derailed by the breaking of the flange of a wheel, and 12 cars were ditched. A brakeman was injured.

26th, Norfolk & Western, Buffalo, W. Va., a freight train was derailed and eight cars were ditched; one trainman was killed and another injured.

unf, 26th, Chicago, Burlington & Quincy, Albany, Mo., a freight train running backward was derailed by running over a cow, and three cars were ditched. Three passengers and one trainman were injured.

eq, 27th, Pennsylvania road, Porter's, Pa., a freight train was derailed by the breaking of the flange of a wheel, and the engine and several cars were wrecked. The engineman and fireman were killed, and one other trainman was injured.

o, 27th, Atlantic Coast Line, Manchester, Va., the locomotive of a freight train was wrecked by the explosion of its boiler. One man was killed and five were injured.

bc, 28th, Southern Railway, Marion, N. C., butting collision of freight trains, wrecking both engines and several cars. One fireman was killed and several trainmen were injured. It is said that an operator neglected to deliver an order to the eastbound train.

bc, 28th, Pittsburgh, Cincinnati, Chicago & St. Louis, Canonsburg, Pa., butting collision of passenger trains, both running at good speed. One engineman and one brakeman were injured. It is said that the collision was due to a misunderstanding of orders.

unx, 28th, Chicago, Rock Island & Pacific, Avoca, Iowa, an eastbound passenger train was derailed while running at high speed (said to be faster than 60 miles an hour) and ran a long distance on the sleepers; but only the front cars were damaged and no passengers were seriously injured.

*unx, 28th, Great Northern, Ojata, N. Dak., a passenger train was derailed while running at full speed, and six passenger cars were ditched. The baggage car took fire. One mail clerk and several passengers were injured.

bc, 29th, Wheeling & Lake Erie, Kingsway, Ohio, butting collision of freight trains, wrecking both engines and 15 cars. One engineman was killed and one fireman injured.

xc, 29th, Chicago, Burlington & Quincy, Alma, Wis., a gravel train backing into a side track was run into by another gravel train, and several cars were wrecked. The chief engineer of the road, riding in one of the cars, was killed, and the general superintendent and three other officers were injured.

unx, 29th, Louisville & Nashville, Oxmoor, Ala., a passenger train was derailed and four trainmen were injured.

The Shan-tung Railroad.

The German railroad in the Chinese province of Shantung was opened June 1 from the harbor Tsingtau on Weihei Bay northwestward 114 miles to Weihsien, where are important coal mines, the opening of which has already been begun. There are 318 bridges on this section, of an aggregate length of 10,941 ft. The structures over the two widest streams are temporary, but the permanent structures were far advanced, June 1, and are to be completed by July 1 and next September respectively. The temporary structures have made it possible to push on the construction and to forward the heavy machinery for the coal mines at Weihsien, from which it is hoped to send coal to the sea next September.

The road has been having a native passenger traffic, steadily, though slowly, increasing. The adjacent population is said to have become well disposed and to recognize the advantages of the railroad, though not all prejudices are yet removed.

The earthworks and foundations of bridges are in progress on a section of 50 miles west of Weihsien and it is expected to have 35 miles of it open by next December. Great efforts will be made to extend the track as soon as possible to the 164th mile post, where a bridge, 1,300 ft. long must be built over the Tse-ho. This bridge it is hoped to complete early in 1903. But before that time 31 miles are to be graded from the site of the bridge on the other side of the river to Choutsun, an important silk market, which it is hoped to reach with the track next April. The concession calls for the completion of the line to Tsinanfu, very near the Hoang-ho, by June 1, 1904. German steamers have brought 21 cargoes of materials and rolling stock for this railroad, including 20 locomotives, 40 passenger and baggage cars and 470 freight cars.

Foreign Railroad Notes.

Some months ago the Berlin Railroad Directory was entrusted by the Prussian Minister of Public Works with the duty of obtaining the wooden railroad ties for the whole State Railroad system (nearly 20,000 miles), and then with preserving them by the processes in use. Now it is further ordered to make a special study of wood-preserving processes and of new methods proposed, and it will maintain a laboratory for testing such processes and their products.

Switzerland has about one-third the area of the state of New York and only 3,000,000 inhabitants. Its products are popularly supposed to be chiefly glaciers, avalanches and cheese; but to these, it seems, must be added railroad publications. An industrious librarian in Berne has compiled a catalogue of the Swiss railroad literature, the titles of which alone occupy 374 closely printed pages, with some 5,000 titles.

The Swedish State Railroads have had their working expenses so increased since 1897 that the interest on the investment has been reduced nearly one-half. The gross earnings per mile were 21½ per cent. more in 1900 than in 1897, and decreased very little in 1901, but the expenses per mile increased no less than 69 per cent. from 1897 to 1901 and over 80½ per cent. of the earnings in the latter year, resulting in a reduction of 45 per cent. in net earnings, which yielded 2.37 per cent. interest on the investment.

A Disk for Hand Signaling.

In a communication to the editor, which was published in the *Railroad Gazette* a few months ago, there was a recommendation that, in hand signaling, in the day time, trainmen should improve the efficiency of their work by using handkerchiefs, to emphasize the motions of their hands. In ordering that daylight motions shall be uniform with those which are used at night, a decided disadvantage has been introduced, for the human hand, even in a strong light, is much less suitably adapted to the purpose under consideration than is a lamp moved up or down or horizontally, at night. We have not observed any marked increase in the use of handkerchiefs since the appearance of the recommendation referred to, and we are unable to say whether or not the arguments presented found favor with our readers; but that the principle is a good one we have evidence in the fact that a couple of Ohio railroads have adopted a metal disk for the purpose for which the handkerchief has been recommended. The shape of this disk is shown in the accompanying drawing, Fig. 1, which shows it about one-fifteenth the size of the actual disk. The Hocking Valley road has been using this signal for several months, and it has lately been adopted by the Ohio Central. Disks are carried in the cabooses of freight trains and on the engines. The disk is made of IX tin, stiffened by a frame of No. 6 iron wire. One side is painted white, with a black center, as shown, and the other side is painted red. Mr. M. S. Connors, who is general superintendent of both of the roads named, informs us that he is going to provide metal disks for use instead of flags as markers on the cabooses of his freight trains. One of these "tin flags" is shown in Fig. 2. The spiral spring appears to be a part of the staff, and is inserted for the purpose of making a flexible support for the metal disk, which is heavy enough to be affected by the violent jarring of the car at high speed. The disk is made of No. 24 sheet steel. These markers can usually be seen further than cloth flags, and it is expected that they will cost less, as one of them can be bought for the amount that would be required to buy seven cloth flags. By repainting once a year the disk should have a long life.

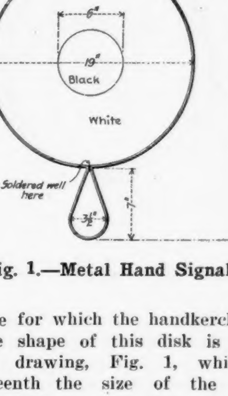


Fig. 1.—Metal Hand Signal.

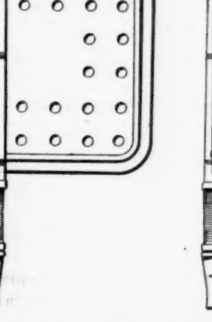


Fig. 2.—Metal Tail-End Signal.

Early History of the Delaware, Lackawanna & Western Railroad and Its Locomotives.*

BY HERBERT T. WALKER.

PART VI.—THE SOUTHERN DIVISION.

In 1851 the company, in accordance with a provision of their charter, made an issue of $900,000 of 7 per cent. bonds, payable in 1871. The whole of these were taken at par by the original stockholders.

Towards the latter part of the same year, the engine "Ithaca" (Fig. 2) was received from the C. & S. R. R. and put into passenger service, Mr. Merrill, who was mentioned in the description of that railroad, accepting the position of fireman. This engine was less satisfactory than the others, owing to the large driving wheels.

The only obtainable account of the engine "Abington" is that it had an elliptical stack, that is to say, the stack was elliptical in horizontal section, the major axis coinciding with the longitudinal center line of the boiler. Whether this was designed as a wind cutter or an improved spark arrester cannot now be learned.

The next engine to come from the builders was the "Keystone," arriving in April, 1852. It was built by William Swinburne, of Paterson, and had a Bury firebox, six coupled driving wheels 48 in. diameter and a four-wheel truck. The cylinders were 18 in. diameter by 20 in. stroke, pitched on a steep angle. The connecting rods worked on the middle pair of driving wheels, having their bearings inside the coupling rods. The link motion was of the "Gooch" design. No drawing of this engine can be found. The late Mr. Watts Cooke was related to Swinburne and had search made among his papers for drawings or sketches, but without success. Mr. Cooke stated that Swinburne was at one time a pattern maker in the shops of Rogers, Ketchum & Grosvenor, and subsequently commenced business for himself as an engine-builder. The building where his shops were located is now owned by the Erie Railroad, situated on the corner of Market street, Paterson, and their main line. Swinburne made some good engines, but failure to collect his debts caused him to retire from business.

Between June 14 and July 23, 1852, four freight locomotives were received. Their names were "Ontario," "Niagara," "Genesee" and "Buffalo." They were built by Rogers, Ketchum & Grosvenor, and were all 10-wheelers, with six coupled driving wheels 54 in. diameter, outside cylinders 17 in. diameter by 24 in. stroke, and wagon-top boilers. Their price was $10,500 each. The railroad company reported that the performance of these engines was "admirable," but no drawings of them can be found.

In May, 1852, eight copper flues were ordered of Rogers, Ketchum & Grosvenor for the "Pioneer," showing that the engine was still in use, and on August 18 of the same year an order was entered for a new single crank axle for engine "Lackawanna," the old one having become broken. These inside-connected 10-wheelers thus gave much trouble.

Towards the close of the year 1852, Superintendent Dotterer inaugurated an improved train service, as shown by the appended copy of the advertisement:

LACKAWANNA & WESTERN

RAIL ROAD.

NEW ARRANGEMENT.

ON and after MONDAY, October 20th, 1852, the Mail Passenger Train will leave Scranton at 11 15, A. M. Arrive at Great Bend at 1 43, P. M., connecting with the Express Passenger Train East and West, on the N. Y. & E. R. R.

Returning, will leave Great Bend at 3 40, P. M. Arrive at Scranton at 6 10 P. M.

A Freight Train with Passenger Car attached, will leave Scranton at 2 30, P. M. Arrive at Great Bend at 6 40, P. M., connecting with the Mail Passenger Train East and West, on the N. N. & E. R. R.

Returning, will leave Great Bend at 6, A. M. Arrive at Scranton at 10 15 A. M.

By order of

D. H. DOTTERER,
Superintendent.

Scranton, Pa., Dec. 20, 1852. 5-tf.

In the year 1853 two freight engines named "Wyalusing" and "Pocono" were received from Danforth, Cooke & Co., of Paterson, N. J. They were of similar design to the "Ontario," but neither drawings nor particulars are obtainable and they will be passed over with some other engine of the same period, as a bare recital of their names and dimensions would be without interest, and more important matters now await our attention, for in the course of time the desirability of getting a direct communication with New York instead of the circuitous route via Great Bend and the Erie Railroad began to occupy the minds of the directors. The advantages of such an extension by which coal and freight could be transported directly to tidewater, to say nothing of the time that would be saved by passengers to and from the metropolis, were beyond question, but the ways and means of accomplishing such a result were very different matters. The purchase of land, and the cost of constructing a railroad all the way from Scranton to New York appeared to be too great an undertaking to a majority of the directors, but the more enterprising urged that it would be possible to make connection with some railroad already built in the State of New Jersey by which the Lackawanna trains could reach the north bank of the Hudson River.

This was a practical idea, and assumed tangible shape in the year 1853, but, as in previous cases, we shall have to go back to a period long before that year in order to get at the origin of the railroad division about to be described.

Again opening Hollister's "History of the Lackawanna Valley," we learn that as early as the year 1826, Mr. H. W. Drinker, an extensive landed proprietor in the district commonly known as the "Beech Woods" or "Drinker's Beech," obtained a charter for a railroad to connect the Susquehanna River at Pittston with the Delaware at the Water Gap, the course to be up the Lackawanna from the former point to Roaring Brook, which would take in "Slocum Hollow" (now Scranton), thence up the latter stream to Lake Henry, crossing the head springs of the Lehigh, down the Pocono and the Analomink to the Gap, but nothing practical was done until 1830, when a subscription of a few hundred dollars was obtained, and with this limited fund Mr. Drinker and his associates were enabled to employ Major Ephraim Beech, C. E., to run a preliminary survey over the country following a line much the same as the railroad that now runs from Scranton to the Delaware River, but for want of public interest and sufficient funds nothing further appears to have been done with the "Drinker" railroad until 19 years later, when the matter was revived and a new charter was obtained by the Delaware & Cobbs Gap Railroad Co., which was incorporated April 7, 1849, but was not published until 1851 owing to the fact that the tax had not been paid subsequently. The company were granted a right to build a railroad beginning at the river Delaware at or near the famous "Water Gap" to a point terminating at or near "Cobbs Gap" (eight miles southeast of Scranton) with the right of extending the southern terminus of the road down the Delaware River so as to connect with the Belvidere & Delaware Railroad, and for this purpose to construct a bridge across the Delaware River.

The first meeting of the commissioners was held at the home of Jacob Knecht in Stroudsburg, Nov. 28, 1850, and the first meeting of the stockholders for the election of officers was held at the house of Stroud J. Holinshead, also in Stroudsburg, Dec. 26, 1850, when it appears that the Lackawanna & Western Railroad Co. were already interesting themselves in the project, for we find that the irrepressible Col. G. W. Scranton was elected president. After a period of over two years the L. & W. R. R. Co. settled down in earnest to prosecute the long talked of scheme, and at the beginning of 1853 the company purchased the original charter of the Drinker Railroad of Mr. Drinker for the sum of $1,000, and immediately after this a joint application was made by the company and the Delaware & Cobbs Gap Company for an act of the Legislature for their consolidation, which was approved March 11, 1853, and the union was consummated under the present name of the Delaware, Lackawanna & Western Railroad. George D. Phelps continued as president of the consolidated company and Col. G. W. Scranton as one of the managing directors. The books were then opened for subscriptions to increase the capital stock, which at the date of consolidation amounted to $1,441,000, and such was the confidence felt in the success of the enterprise, not only by the original stockholders but by other capitalists, that the whole sum required—$1,500,000—was taken in a few days.

In the meanwhile Chief Engineer Major Edwin McNeil was utilizing every hour of daylight in making the preliminary surveys for this great undertaking, for great it was then, although it may not be so considered in these days of gigantic engineering feats. A glance at the map will show that there is not a single town of any size, except Stroudsburg, between Scranton and the Delaware Water Gap. At the time the railroad was being built Stroudsburg was a mere village, and but few of the hamlets dotting the country on the line of the road to-day were existing in the year 1853. The chief engineer was confronted by two serious problems from the beginning, although the difficulties were not fully realized until long after the work had commenced. They were, first, the almost interminable forests that clothed the rough undulating spurs of the Blue Mountains through which the line would have to be driven, with the formidable Mount Pocono rearing his uncompromising head as if to bar all progress, and, second, the peculiar obstacles encountered by having to draw supplies from regions remote from ordinary lines of communication and from every kind of market, rendering it difficult of access for both men and materials. The soil proved to be exceedingly hard, and the price of labor gradually reached an unprecedented figure, so that at one time it appeared as if men could not be had at any price. However, a start was made by letting the grading and masonry contracts in June, 1853, operations were commenced in the following month and were continued during the rest of the year as well as the severe winter would allow.

As it was necessary to distinguish the road running between Scranton and Great Bend from the one in process of construction, the former was named the Northern Division, and the latter was known as the Southern Division.

The close of the year 1853 is a land mark in the history of the D., L. & W. R. R., bringing us, as it does, to the end of the period when wood burning locomotives were used exclusively, but before describing the first anthracite coal burning engine for this railroad, we will, with the reader's permission and company, go back in our minds to the early fifties, and take a ride on the old Lackawanna "mail train," so different from the new order of things as to have scarcely one feature in common.

It is night, and we are at Great Bend with the Lackawanna train, awaiting the arrival of the Erie passenger train from New York. It has been raining all day and is still pouring in torrents. The Erie train is four hours late already, but we must wait for it, however long it may be, for we are here to take the passengers and mails to Scranton.

In course of time, the headlight of the Erie train looms dimly in the distance, and on its arrival, passengers and mails are quickly transferred to the Lackawanna cars. Meanwhile, we will walk down to our engine and see what she looks like. The first thing we notice is the profusion of brass work, although it is dull and tarnished by the weather, but she no doubt looks handsome when cleaned up. The stack and wheels appear large in proportion to the small boiler, and the six-foot gage seems to throw the whole machine out of proportion. The tender, stacked high with wood that but a short time since was growing in the Pennsylvania forest, has two brake-wheels, one on each side, for the front and rear trucks are braked separately. But we will not stand in the rain, for our friend, Mr. E. J. Rauch, is the "engineer" to-night, so we will climb up and take our places in the cab with him. He gives us a short nod and remarks that it's rough weather, and there's going to be no fun to-night for anybody. The fireman (short pipe in mouth) says nothing, for nobody feels like talking, and every one wants to get home to Scranton and to bed. There is no wood passer, as they are only employed on freight engines.

We glance around the cab, and note how barren it looks. We see neither steam gage nor water glass. There are no injectors, no lubricators, no brake-valve—in short, scarcely any of the appliances for running a modern locomotive. All we see is the curve of the high-domed fire-box (studded with rivet heads) that disappears near the roof of the cab, and the brass casing of the safety-valve spring balance. There is a throttle lever, reversing lever, sand box rod, three or four gage cocks and a couple of ropes—one for the bell, the other for the whistle. We do not observe these details with much comfort, as, in the absence of a blower and the presence of a "patent stack" (never mentioned by engine men without profanity) the wood fire sends considerable smoke into the cab, and it makes our eyes smart.

Presently we get the signal to start and pull slowly out of Great Bend, rumbling over the wooden bridge that spans the Susquehanna River—now swollen and overflowing its banks, and begin our climb to New Milford Summit. There is a strong side wind and the engine labors, the exhaust steam beating unevenly—for that blamed suspended link motion never did cut off right. The rain beats furiously against the cab windows, but Mr. Rauch cares nothing for weather, and with head and shoulders soaking wet, he leans far out of the swaying cab, keeping an unflinching look ahead, for there is likely to be trouble on such a night as this. Now and again we see his hand trying the gage cocks, his practiced ear telling him whether they blow steam or water. Then he looks into the cab for an instant, and shouts to the fireman to let her have it, for we want to get some sleep to-night if we can. The fireman, with stooping shoulders and legs wide apart, jams the sticks of wood into the firebox, filling every corner from fire ring to bottom row of flues. We look through the wet window glass, but can see nothing save the dull glare of the headlight, and a cloud of sparks, sweeping sideways and taking a journey on their own account over the invisible landscape. From the open fire-door a diverging column of light shoots high into the wet blackness, like the tail of a comet. By it we see the rocking, plunging tender, its front splashed with mud, which, taken in conjunction with the violent lurches made by the engine, leads us to conclude there are some soft places in the track to-night.

If we had any say in the matter, we would suggest a more moderate speed, but Mr. Rauch knows no fear, and his voice is again heard calling on the fireman to keep her hot if he wants to get home to-night. The engine pitches and rolls, the cab shaking as if to knock the glass from the sashes. It is a marvel she stays "on the iron," and occasionally we think she must surely be running on the ties. We look at the fireman, but his stern face, brightly illuminated by the hot fire, shows no anxiety as he methodically feeds the insatiable furnace. Concealing our fears with some effort, and holding on to the side of the cab, we enquire of him about where we are. He replies "Martin's Creek." He spoke at the top of his voice, but his reply was just audible above the roar of the storm and the rattle of the engine. Knowing that we have passed the summit and are on the down grade, we venture to hint something about running too fast, but the fireman shakes his head impatiently; then, seeing we are apprehensive, he shouts in our ears that we shall soon have to slow down, for they are not yet through with the Tunkhannock tunnel (they've been long enough over it, damn 'em) and much time will be lost on the switchback and zig-zag track over Tunnel Hill. The speed appears to be increasing, and holding still tighter to the cab, we begin to wish we were back in the passenger car instead of on this fearful machine that seems to be doing its utmost to destroy itself.

Presently Mr. Rauch sees a far distant speck of light

that appears to be on the track. It is so small that at first he pays little attention to it. It does not move—as it would were it intended for a signal, and, for a few moments he is in doubt. Suddenly the impulse seizes him to stop the engine, for something tells him that he *must* pull up short of that little light. He slams the throttle lever shut, sounds the whistle, reverses, and gives her the sand, the fireman applying the brakes with all his might. These movements are performed in less time than it takes to describe or indeed to read them, and we lean out of the cab, oblivious of the rain, to gaze at what Mr. Rauch is looking at.

As we draw near to the light, which is on the ties and remains perfectly stationary, the headlight of the engine shows us the ghostly figure of a man standing between the rails, bareheaded and waving his hat. The figure, spectral at first, is now revealed as a farmer with hair, beard and clothes streaming with the driving rain. He places his hat upon his head, picks up the light, and steps forward to meet us, just as the engine stops, when Mr. Rauch thunders the inquiry:

"What's the trouble there?"

men of his time) concentrated all their energies to bring about the development of this important part of their trade. Accordingly it was determined to awaken public interest in this class of fuel by advertising it in various ways and by distributing free samples. It must be remembered that there was much prejudice against anthracite coal, and it was not by any means used so generally as it is now. This prejudice had to be overcome, and carloads of coal were actually given away in order to induce parties to give it a trial. With regard to burning it in the locomotives there was a divided opinion, a majority of the directors not being in favor of it for that purpose, as it was thought it could not be made to burn with sufficient rapidity in the limited size of the fire-box of a locomotive engine. But, as Superintendent Dotterer pointed out, Millholland and Ross Winans had already built successful hard coal burners, and there was no reason why similar engines could not be constructed for the D., L. & W. R. R., and, as the poor policy of buying wood for fuel while good coal was waiting in the company's mines began to be apparent, it was ultimately decided to try one anthracite coal burning freight loco-

ness were $191,920.61. Deducting the total expenses of operating, repairs of the road, repairs of machinery and cars, superintendence, etc., which amounted to $95,633.65, a balance of $96,286.96 remained as net revenue to the credit of the general income of the company. The net revenue from the Coal Department was $75,945.09.

The contract with the Post Office Department provided that the company were to receive as compensation for carrying the mails the sum of $2,500 per annum less one-seventh for Sundays omitted, at which rate the amount was $2,142.86.

There were no Sunday trains, but the day of rest was generally put in on repair work, so the employees, especially the enginemen and machinists, had little relief from labor, although this was against the wishes of the Scrantons and some of their brother directors.

The "Anthracite" was completed in April, 1854, Watts Cooke being at that time assistant superintendent in the works of Danforth, Cooke & Co., and having more or less to do with the erection of the engine. Fig. 15 shows the engine as originally built. A glance at the drawing will reveal to what extent Dotterer's "suggestions" were

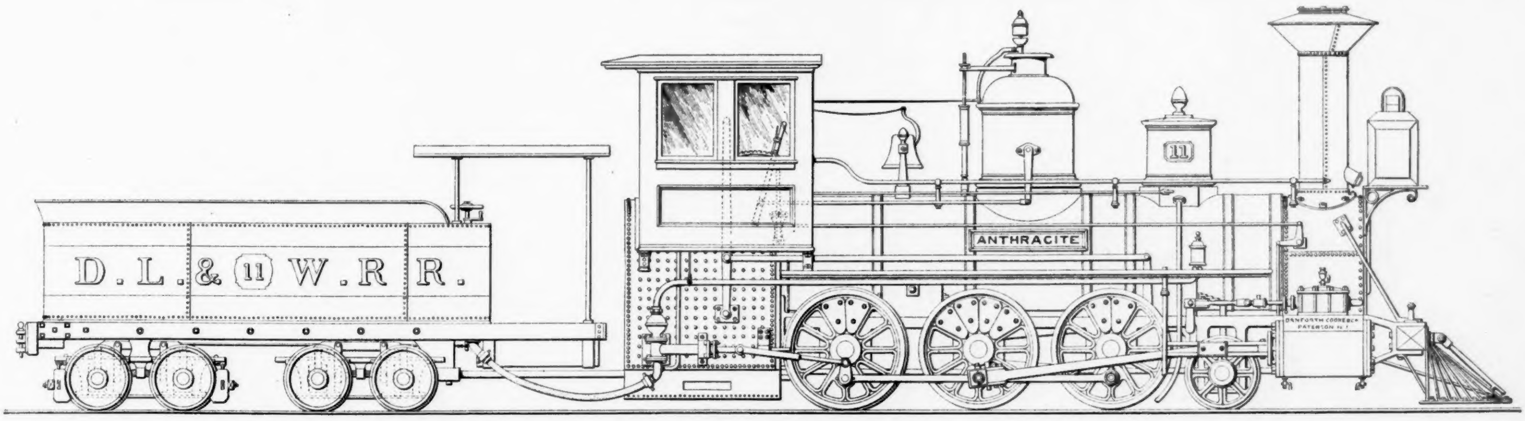


Fig. 15.—Delaware, Lackawanna & Western Railroad First Hard Coal Burner, 1854.

"Wall, Mr. Ingine-eer," replies the farmer slowly, "I reckon you'd better git down and see, for I don't know as this yer bridge is quite safe."

Mr. Rauch swings himself off the engine, as we do also, and, wading along the track we all follow the farmer carrying his light—which proves to be a little lantern with a tallow candle, used by country folk in bygone days.

The man walks on a few yards and then stops, when Mr. Rauch suddenly starts back, exclaiming:

"Bridge! Why man alive there is no bridge. What's become of it?"

"Dunno," replies the farmer, rubbing his face with a red handkerchief, "guess it's down stream."

Conductor and brakeman now arrive with lamps, which are held over the yawning chasm, showing us the bent and twisted rails disappearing in the roaring torrent below, with every scrap of woodwork washed away. As we turn to thank the farmer, Mr. Rauch asks him:

"Why didn't you wave your lantern? It's a wonder I stopped."

"Lantern!" exclaims the farmer, "be jocks, I was waving my hat, and didn't think of the lantern."

Every one feels relieved to think we are not in the bottom of that mountain torrent, and even the grumbling passengers are disposed to admit that matters might be worse, and the discomfort of spending the night in the train falls into comparative insignificance.

The name of that old farmer has been forgotten, but the way in which he saved a trainload of passengers on that black night at Oakley's trestle, with his little lantern, deserves to be recorded.

We will now resume the important matter of the introduction of hard coal burning engines on the D., L. & W. R. R., bearing in mind that for the year 1853 the outlays for construction and equipment had been very heavy, the actual cost having far exceeded the original estimates. By the end of the year the total disbursements for construction, right of way, buildings and contingent and office expenses, with the amount expended towards the construction of the Tunkhannock Tunnel (not then completed) was $2,162,048.75, and the cost of equipment comprising 13 locomotives, 10 passenger and baggage cars, 60 house and platform freight cars, 854 coal cars, machinery and tools for the machine and car shops was $395,724.64. The amount expended up to the end of the year 1853 in the purchase of coal lands and the cost of opening and working the mines was $145,422.01. The company originally worked their own mines, but it was subsequently (January, 1853) deemed expedient to have the work done by contract. The item of wood for the locomotives was a considerable one, two large wood sheds being located at Tunkhannock and Clark's Summit, but the supply was very irregular, the contractors being a shiftless class of men, and the wood was often delivered in a green or unseasoned condition with the inevitable result of lack of steam and train delays.

For this and other business reasons it became evident that anthracite coal would have to receive even more attention than it had, and the Board of Managers, headed by Col. G. W. Scranton, with William E. Dodge and Moses Taylor (who was one of the shrewdest business

motive, and, as the wood burning engine "Wyalusing" built by Danforth, Cooke & Co., was satisfactory, it was thought well to give another order to the same firm. By the courtesy of the late Mr. Watts Cooke a copy of the order as it appeared in the books of Danforth, Cooke & Co. is here given.

OCTOBER 19TH, 1853.

By the Delaware, Lackawanna & Western R. R. Co., per George D. Phelps, President. Letter of the 18th inst.:

"One locomotive engine, with boiler suitable for burning the Scranton anthracite coal, with six driving wheels, outside connected, and fitted with pilot, sand box and

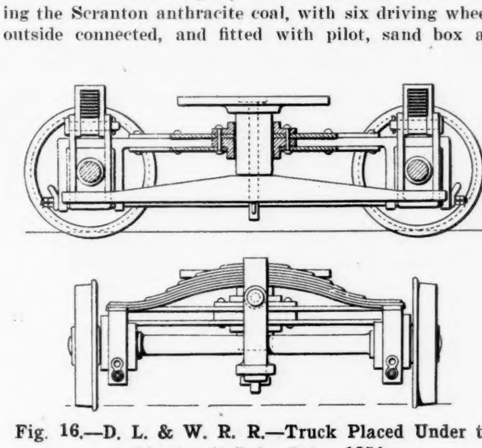


Fig. 16.—D. L. & W. R. R.—Truck Placed Under the "Anthracite" in July, 1854.

pipes, spark arrester, jack screws, wrenches, set of oil cans, lantern and stand, snow scraper and an eight-wheel tender, warranted to be equal in power and speed to the 'Anthracite' now building by you. The name of the 'Anthracite' to be changed to 'Pocono,' and *this* engine to be named the 'Anthracite.'" Engine to be delivered at Great Bend, they paying the freight on the New York and Erie Railroad. Terms cash, or six months notes, adding interest at 7 per cent.

It thus appears that the wood-burning engine "Pocono" had been named "Anthracite" but the railroad company ordered the names transposed. It is evident that the design of the engine was left largely to the discretion of the builders, but Watts Cooke stated that Superintendent Dotterer made many suggestions during the progress of the work.

This brings us to the close of the year 1853, when the engine re-named "Pocono" was delivered and the "Anthracite" was in course of construction, as shown by a note in the railroad company's first annual report stating that, "The company have now nearly completed a model engine of great power, constructed for burning anthracite coal; and should their anticipations in this respect be realized they design at once to order several more of the same character.

During the year 1853, 43,726 passengers, about 100,000 tons of anthracite coal and 10,000 tons of iron as well as 34,000 tons of other freight were transported. The gross earnings from this branch of the company's busi-

embodied in the design, and how much he was influenced by his friend, Millholland, for it is evident that the engine was of the Millholland "Pawnee" class of 1852, several of which were then at work on the Philadelphia & Reading Railroad. The leading dimensions of "Anthracite" were: Cylinders, 17 in. diameter by 24 in. stroke; driving wheels, 51 in. diameter; leading wheels, 30 in. diameter. The wheel base was rigid, the leading wheels not being in a truck. The fire-box had 23 sq. ft. of grate surface. There were two sets of flues, a combustion chamber being located in the barrel of the boiler, similar to the Webb engines now running on the London & Northwestern Railway. This intermediate combustion chamber is shown in the drawings of Millholland's patent dated Feb. 17, 1852. The boiler was 48 in. diameter. The frames stopped at the front of the fire-box, which was about 6 ft. 6 in. wide at the bottom, this being an early example of a "wide fire-box" engine. In describing some later engines, we shall again refer to this important matter.

The coupling rods of the "Anthracite" had solid ends with bushings, but the idea was not new, they having been used by Winans as far back as 1835. The engine driver's cab was mounted on the fire-box and the throttle lever worked on a notched quadrant, the rod passing to the outside of steam dome as shown. The throttle valve was of brass, working in a cast-iron casing. Sometimes it leaked, and sometimes it got jammed, giving much trouble. The exhaust was variable and of the solid plug type, it was operated by the bell crank bracketted to the smoke-box.

The engine was a poor steamer, the fire-box being too small, and the water spaces too narrow, causing the water to leave the sheets when the engine was working hard. The stack had a grating of iron bars laid across the top and as the blast had to be very sharp to get the engine to pull anything of a load these bars were quickly cut out and much fire thrown, to the damage of property along the line. This sharp blast also pulled coal out of the fire-box through the first set of flues, where it would get lodged in the combustion chamber, and there remain, thus stopping up about one-third of the flues. There was a man-hole (not visible in the drawing) for removing the ashes from this chamber.

The tender was of a pattern used by Winans for his "Camel" engines. It had a roof for the protection of the fireman who worked here alone, the engine driver having a cab to himself. This arrangement did not suit the men, as they preferred to be together. Under the above mentioned roof there was a platform on a lower level than the tender frame for the fireman to stand in when he was firing. This place was generally called the pit, but with a grim humor not uncommon in railroad men, it was likewise known as the "kitchen," for as a matter of fact more than one poor fireman has been roasted to death in these miserable contrivances. The tender was connected to the engine by a drawbar coupled to the bottom of the ash-pan, which was re-enforced by a brace in the form of a V, the open end being bolted to the bottom part of the frame. At each side of the apex of the V there was a jaw admitting the drawbar which passed under the tender pit to a framework extending across the tender frame—part of it can be seen in front

of the leading truck wheel. If there was a collision and the fireman did not jump out of the pit in time, the chances were that the tender would break up the wooden pit frame and jam the man against the boiler head, holding him there, with the result above described. The only way to clean out the ash-pan was by the side openings, as shown.

It was decided that Watts Cooke should take the engine under steam to Scranton, and some time in the first week of May, 1854, they left Paterson on the Erie Railroad, Thomas Humblebee driving the engine, and William White acting as fireman. It was an anxious time for Watts Cooke, for he found, on taking some of the sharp curves which abounded on the old Erie Railroad, that the engine would not track well, and when near Cochecton it ran off the rails. No great damage was done, however, except the bending of the heavy drawbar, which Mr. Cooke and his men took out with much labor, and, building a fire of hemlock bark from the woods, they straightened it out. Then getting the engine on with jackscrews, they went on their way (not rejoicing) and arrived at Scranton on May 10. The "Anthracite" ran off the track on other occasions and after a few trips, Watts Cooke returned to Paterson, and, with his brother John, built a truck, illustrated by a longitudinal section and end view in Fig. 16. The frame was simply two wrought-iron side bars with jaws to hold the journal boxes. These frames were connected together by plates of boiler iron rivetted top and bottom, said plates having two cast-iron rings in the center for the reception of a sleeve forming part of the saddle that supported the smoke-box, the center pin passing through the sleeve, and the single equalizer which was centrally located. The saddle sleeve thus rested on the central equalizer which was connected at either end by hangers to the springs, the ends of said springs resting on the frames immediately above the journal boxes. The truck had thus two springs and one equalizer. It appears to have given satisfaction, but the design was never repeated.

With the truck, the engine tracked well enough, but as it did not steam well, the combustion chamber was removed and one next to the fire-box substituted. Mr. Henry F. Colvin, Secretary of the Rue Manufacturing Co., of Philadelphia, ran this engine for three years. Mr. Colvin has given the writer much information regarding these early engines. In 1857 the engine was rebuilt, and the cab was put forward, surrounding the steam dome. A blower was also put in, for in its absence, the only way to get a draft when standing was to disconnect the valve stem from the rocker, and place the valve in a midway position so that steam would blow through the ports and up the chimney. The engine was entirely rebuilt in 1872, and is still running, with a new boiler and fire-box for burning fine anthracite coal.

(*To be Continued.*)

The Visit to Schenectady of the Master Mechanics.

As in previous years, the Schenectady Works of the American Locomotive Company extended an invitation to the members of the Master Mechanics' Association to visit the plant on Tuesday, the 24th, the second day of the convention. A special train on the Delaware & Hudson left Saratoga at 1 o'clock and on arrival at Schenectady luncheon was served on tables in the new boiler shop, which is under roof, but in which none of the tools have yet been installed. Some 300 guests were provided for and after the luncheon the party was divided into small groups and taken in charge by a reception committee of the employes, who conducted them through the various departments of the works.

The plant is being extended, two large new buildings being in course of construction. One is the boiler shop and the other a foundry, both buildings being 225 x 675 ft., of steel and brick construction. The equipment from the old shops for these two departments will be moved into the new buildings and new tools and machinery added to make the equipment complete. The enlargement of the plant is across the canal from the old works and a large tract of land some 70 acres in extent has been bought by the company to be used in providing for present and future needs. The present force of between 3,500 and 4,000 will be largely augmented and the capacity of the plant considerably increased.

In the shops attention was attracted to locomotives for export that were under way, there being an order of 72 for Japan and 14 for South Africa, the latter of which are being equipped with copper fire-boxes. Wide fire-box locomotives similar to the types on exhibition at the convention were noticed in the erecting shop.

The party left Schenectady for the return trip to Saratoga at 4:30. The excursion was in charge of Mr. J. F. Deems, General Superintendent of the works.

A Comparison of Rolling Stock.

A comparison of rolling stock practice in India, America, Great Britain and Australia is contained in a paper entitled "Standardization Considered in Connection With Indian Railway Rolling Stock Practice," by Lieut.-Col. Gardiner, R. E. (retired), chairman of the Madras Railway Company and formerly General Manager of the East Indian Railway. The paper has been privately printed and circulated among the author's friends. Comparing the standard (5 ft. 6 in.) gage railroads of India with the standard (4 ft. 8½ in.) gage line of England and America, Col. Gardiner gives the following figures for locomotives without tenders:

	Indian.	English.	American.
Heaviest axle load, tons	15	18.65	23.44
Av'ge gross weight, passenger, tons	43.6	51.80	72.12
Av'ge gross weight, goods, tons	39.0	48.59	80 to 85
Av'ge heat'g surf., passenger, sq. ft.	1,216	1,497	2,585
Av'ge heat'g surf., goods, sq. ft.	1,276	1,427	.....
Av'ge boiler pressure, lbs.	160	180	195
Av'ge tractive power, pass., tons	5.55	6.46	8.32
Av'ge tractive power, goods, tons.	7.75	7.79	8.32

Comparing the Indian meter gage (3 ft. 3⅜ in.) with the Colonial 3 ft. 6 in. gage, the following results are given:

	Indian.	Colonial.
Heaviest axle load, tons	8	11.80
Average gross weight, tons	27.5	45
Heaviest weight, tons	32	51
Average heating surface, sq. ft.	847	1,123
Average boiler pressure, lbs.	167	174
Average tractive power, tons	4.55	7.32

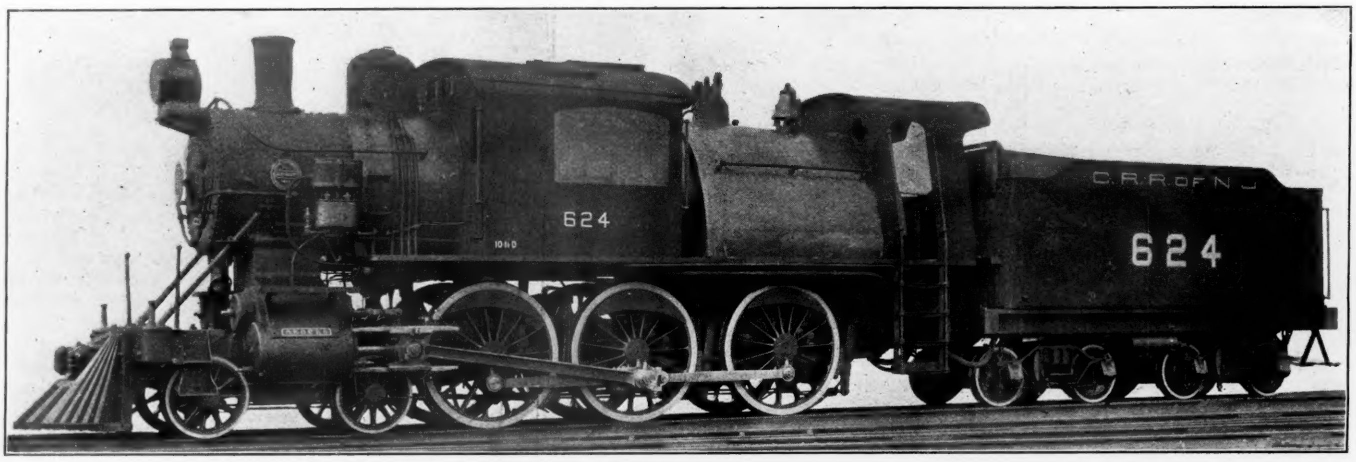
"The chief fact prominently brought to notice in these figures," remarks Col. Gardiner, "is the great inferiority in axle loads, gross weights, heating surface and tractive power of the Indian engines of both gages. Comparing gross weights of American, English and Indian broad-gage railways, it is known from other available statistics that an American 4 ft. 8½ in. engine runs up to 140 tons in weight and hauls 3,500 tons. English locomotives weigh as much as 107 tons, whilst Indian engines are not allowed more than 86 tons and haul in practice, say, a maximum of 1,200 tons only. Again, a Colonial 3 ft. 6 in. engine weighs 51 tons, versus an Indian meter gage of 32 tons, and its tractive power is probably at least as 8 to 5. Thus the Colonial gage, only 6.7 per cent. wider than the meter gage, takes an engine nearly 60 per cent. heavier and actually 8.5 per cent. more than the 5 ft. 6 in. gage, and nearly equal to that of the most powerful 5 ft. 6 in. engine. In the same way, although the 5 ft. 6 in. gage is 11.7 per cent. larger than the 4 ft. 8½ in. gage, the engine for the former is nearly 25 per cent. lighter than the heaviest English engine and nearly 63 per cent. lighter than the heaviest American one. Again, though there is not much difference in the tractive powers of the English and Indian broad-gage engines, the American actually averages 50 per cent. higher than the Indian. As regards wagons, American best practice per foot run is 66 per cent. better, some of the ore cars even going as high as 2½ tons per foot run and the best English 4-wheeled practice is 11 per cent. superior, although their gages are 11.7 per cent. worse than the Indian 5 ft. 6 in. gage. American goods axle loads, moreover, go as high as 16½ tons per axle and these loads, as also the heaviest engines, are daily run over roads laid with 85-lb. rails."

The reason why India is so far behind in rolling stock practice is, in Col. Gardiner's opinion, that in that country "the policy of fitting the road to the stock as the most important feature in successful railway work has never been given the prominence it deserves and which has been accorded to it elsewhere. The tendency has always been, on the other hand, to give undue precedence to economy in engineering construction and maintenance and to limit the earning power of the line by a restricted expenditure on the road. American practice, on the other hand, has for long recognized the preeminent importance of the haulage factor and home practice appears now awakening to the same fact. It is to be hoped that those responsible for Indian policy in this respect will think again before allowing restrictive conditions imposed in the interests of the road to unduly interfere with the progressive spirit of the present day. The lowest railway freight rate in the world for long-distance coal traffic (believed to be charged on the American railways) is understood to be $^1/_{18}$th of a pie per maund per mile, which, translated into English terms at the exchange of the day, is equivalent to half a farthing a ton-mile. Such a rate is only achieved in America by the handling of 3,500-ton trains with powerful engines, having axle loads up to 23 tons and wagons with 16½-ton axle loads and gross loads of 2 tons per foot run. India needs cheap inland transportation quite as badly as America and if it is to attain it the powers that be must not only allow but encourage Indian railways to emulate American practice." Col. Gardiner also expresses himself strongly in favor of the fitting of the freight cars of Indian railways with automatic brakes. He emphasizes "the very great advantage of shortening the heavy trains of the future by adding to the permissible width of the stock," so as to bring this up to American and Continental (*i. e.*, European) standards.

Ten-Wheel Passenger Locomotives—Central Railroad of New Jersey.

The accompanying illustrations show one of 25 10-wheel passenger locomotives recently built by the American Locomotive Co., Brooks Works, for the Central Railroad of New Jersey. Several of these engines are now being used in suburban express service. They are designed to burn fine anthracite coal and have wide fire-box with a grate area of 67.7 sq. ft.

The cylinders are simple 19 x 26 in., and have piston



Ten-Wheel Passenger Locomotive for the Central Railroad of New Jersey.
Built by the BROOKS WORKS, AMERICAN LOCOMOTIVE COMPANY, *Dunkirk, N. Y.*

valves. The valves are inside admission, 1⅛ in. steam lap, line and line on exhaust edges, and 5⅝ in. travel in full gear. The drivers are 69 in. outside diameter, the total heating surface is 2,187 sq. ft., and the working steam pressure 210 lbs. per sq. in.

The total weight of engine is 161,000 lbs., with 120,000 lbs. on drivers. The weight of tender, loaded, is 106,000 lbs. These proportions give a journal load of 20,000 lbs. per driving wheel axle.

All wheel centers are of cast-steel. The tender is of the 8-wheeled steel frame type with steel channel underframe, and all metal standard trucks of the C. R. R. of N. J.

A general description of the locomotive follows:

Fuel	Fine anthracite
Weight on drivers	120,000 lbs.
Weight on truck wheels	41,000 lbs.
Weight, total	161,000 lbs.
Weight tender loaded	106,000 lbs.
General Dimensions.	
Wheel base, total of engine	24 ft. 1½ in.
Wheel base, driving	13 ft. 3 in.
Wheel base, total (engine and tender)	51 ft. 9¾ in.
Length over all, engine	38 ft. 5 in.
Length over all, total engine and tender	60 ft. 5 in.
Height, center of boiler above rails	9 ft. 5½ in.
Height of stack above rails	14 ft. 11 in.
Heating surface, fire-box	156 sq. ft.
Heating surface, tubes	2,031 sq. ft.
Heating surface, total	2,187 sq. ft.
Grate area	67.7 sq. ft.
Wheels and Journals.	
Drivers, number	6
Drivers, diameter	69 in.
Drivers, material of centers	Cast steel
Truck wheels, diameter	36 in.
Journals, driving axle, size	8½ x 11 in.
Journals, truck axle, size	5½ x 12 in.
Cylinders.	
Cylinders, diameter	19 in.
Piston, stroke	26 in.
Piston rod, diameter	3¾ in.
Main rod, length center to center	9 ft. 10 in.
Steam ports, length	24.2 in.
Steam ports, width	2 in.
Exhaust ports, least area	65 sq. in.
Valves.	
Kind of	Piston
Greatest travel	5⅝ in.
Outside lap (exhaust)	0 in.
Inside lap (steam)	1⅛ in.
Lead in full gear	$^1/_{32}$ in.
Lead, constant or variable	Variable

Boiler.

Type of	Wagon top
Working steam pressure	210 lbs.
Material in barrel	Steel
Diameter of barrel (front)	60⅞ in.
Seams, kind of horizontal	Sextuple
Seams, kind of circumferential	Triple
Thickness of tube sheets	¾ in.
Crown sheet stayed with	Radial stays
Dome, diameter	30 in.

Fire-box.

Length	9 ft. 1 in.
Width	7 ft. 7 in.
Depth, front	59½ in.
Depth, back	46 in.
Material	Steel
Water space, width	Front, 4 in.; sides, 6 in.; back, 4½ in.
Grate, kind of	Rocking and water tubes

Tubes.

Number	282
Material	Charcoal iron
Outside diameter	2 in.
Length over sheets	13 ft. 10⅛ in.

Smoke-box.

Diameter	65 in.
Length	63 in.

Other Parts.

Exhaust nozzle	Single
Exhaust nozzle	Permanent
Exhaust nozzle, diameter	5 in.
Exhaust nozzle, distance of tip below center of boiler	2⅛ in.
Netting, wire or plate	Wire
Neting, size of mesh	2½ x 2½ in.
Stack	Taper
Stack, least diameter	15 in.
Stack, greatest diameter	17 in.
Stack, height above smoke-box	2 ft. 9 in.

The Master Mechanics' Convention.

(Concluded from page 525.)

is a necessity for running one or more engines around the others. If we have but one track into the roundhouse over the clinker pit, this cannot be done, and it may easily happen that some important train may be held there from 15 minutes to an hour, to get the engine over the clinker pit. If there are two tracks over the clinker pit, this matter is very easily handled.

Another matter in connection with clinker pits, well worth considering, is a track for cinder cars long enough to hold cars for a day's supply of ashes. This takes the clinker pit a little distance farther from the roundhouse but enough can be saved by it to more than pay for this. If the depressed track will hold only three or four cars, it is necessary to hunt up a switch engine four or five times a day to get out the ash-pit cars and set others in. If the location is favorable it is a good plan to have it long enough and the grade such that the day's supply of cars can be on the uphill side of the ash-pit. Then as a car is filled with ashes it is simply dropped by gravity and another car from above the pit is dropped into its place.

Another matter is the location of the ventilators over the track in the roundhouse. It is not unusual practice to have these ventilators between the pits. If the ventilator is located over the pops or steam dome, over the center of the pit, almost all the steam will be taken from the roundhouse.

Mention is made of a pipe about the roundhouse, through which the locomotives can be blown off. The largest diameter of pipe mentioned for this purpose is 5 in. I will be glad to know if any experiments have been made to determine how long it takes to blow off an engine through a 5-in. pipe. I thought at one time that we were doing a great deal when we put up a 4-in. pipe in the roundhouse for blowing off steam, but I found it was a waste of time and money. It took us much longer to reduce the pressure through a 4-in. pipe than when the steam was allowed to escape out of doors.

In connection with the sand house, the plan submitted by the committee contemplates unloading the sand on to the ground floor of the sand-drying house. The plans from there on are very complete and labor saving in that the sand is elevated by compressed air and delivered to locomotives much as water is. It occurs to me that it would make the plan much more complete and economical if the sand was loaded from the end of the coal trestle into a bin above the stoves.

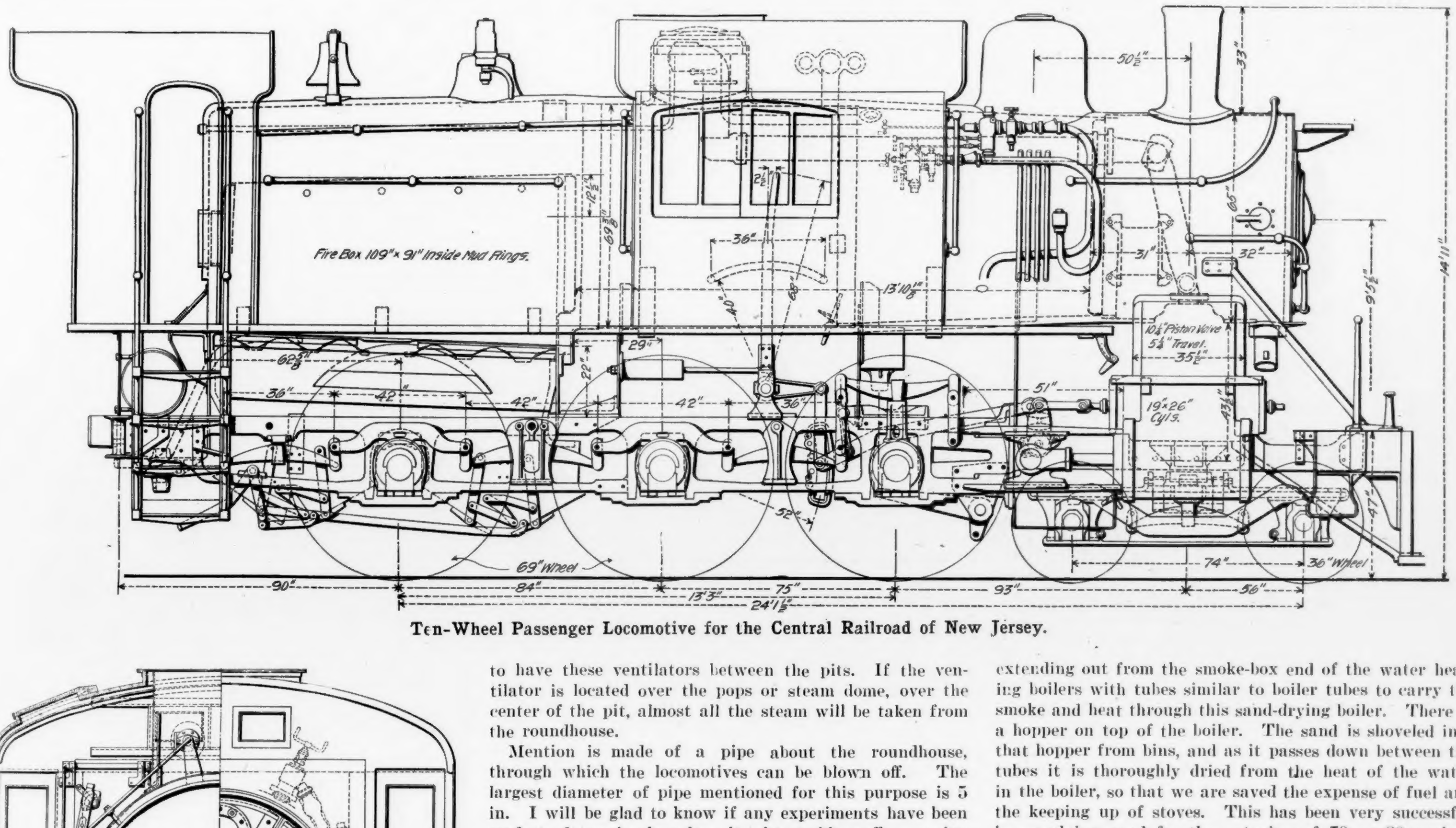
I want to call attention to the importance of organization and system. That is more vital than the arrangement of the roundhouse itself. I have in mind a roundhouse in which the roundhouse board has a number of extra columns, and by extra columns I mean such as are not on the usual roundhouse board, and not shown in any of the samples I find in the report. There is a column on which the call-boy makes his mark when he has called the engineer and fireman. There is a column on which the machinist makes his mark, indicating his work is done on the engine opposite this mark. And so there are various columns for the different branches of work necessary to be done with a locomotive before it is ready for service. The consequence is that the roundhouse foreman can tell you at once when such and such an engine will be ready, simply because the marks upon the roundhouse board tell him how the work is progressing. One of the details in this system is a fair sample of all the rest. As soon as the flue man has inspected the flues of an engine and has put the fire-box in good shape, he puts a circle on the inside of the fire-door. The fire lighter coming around to get the engine ready for service does not have to hunt up the boiler man or the roundhouse foreman or anybody else. He simply looks at the door. If the flue man's mark is there he knows that locomotive is ready to be fired. You can easily see when a system of that kind is carried out in detail, the large amount of time which is saved, the greater information which everybody has and the greater certainty of operation.

Mr. F. F. Gaines (Lehigh Valley)—Regarding the wooden smoke-jacks lined with lead, I ask the members of the Association if they have found them charred under this lead lining? Objection has been made to them on the ground that they are not safe, at least the insurance underwriters will not allow them to be used. There are several arrangements for drying sand by both the steam and stove, but I do not see any mention made of the fact which has been brought forward recently that the use of a stove in drying sand burns it and drives out the water of crystallization, and the sand when so dried loses a great deal of its abrasive properties.

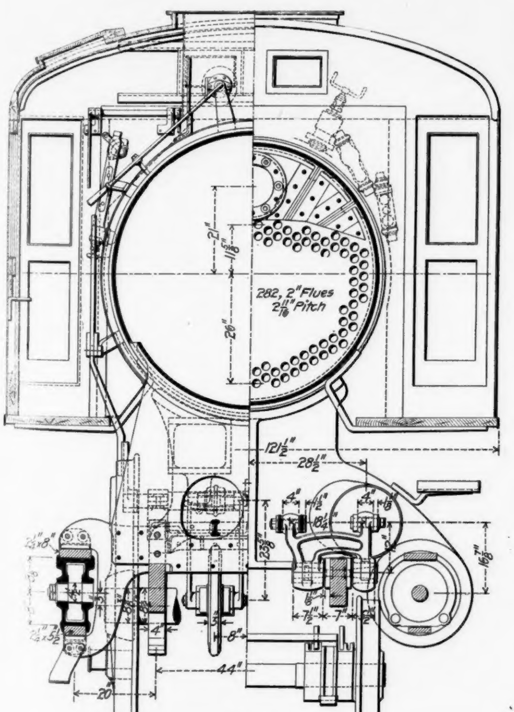
Mr. Robt. Miller—I would say in regard to wooden smoke-jacks that our experience with them has hardly been satisfactory. We have had a number of cases on each of our roundhouses, where the wooden jacks are used, of their taking fire. I would not like to recommend the wooden smoke-jack as being the best thing for a roundhouse.

We use a locomotive boiler for the heating of water for the washing out of our boilers in the roundhouse, and in connection with that we have an extension boiler extending out from the smoke-box end of the water heating boilers with tubes similar to boiler tubes to carry the smoke and heat through this sand-drying boiler. There is a hopper on top of the boiler. The sand is shoveled into that hopper from bins, and as it passes down between the tubes it is thoroughly dried from the heat of the water in the boiler, so that we are saved the expense of fuel and the keeping up of stoves. This has been very successful in supplying sand for the outgoing of 70 or 80 engines in the 24 hours. The sand in passing through this boiler drops into a sand reservoir and from there is carried into a tub and supplied to the locomotives by gravity. We have found this very economical and very satisfactory, and the sand in no case is over-heated or burned, as is often the case when stoves are used.

Mr. W. D. Robb (Grand Trunk R. R.)—I have found that to get sand properly dried so that it will not clog or cake in the box it is necessary to burn it and heat it by a stove. I have not noticed mention made of appliances for washing out. The practice on the Grand Trunk System is that no steam or water is allowed to be blown into the shop and no water is allowed to run into the pits. Outside of each shop, there is at least one tank, with a partition, and these tanks hold from 8,000 to 10,000 gallons. There is an underground pipe connected with the blow-off cock, which runs the water into these tanks. There is an overhead pipe that takes the steam to the tanks. As soon as the engine is blown off and the water drawn off, the plug is taken out, and the washing operation commences. The water is drawn out to wash out from one section of the tank, and it is as hot as a man can handle it. One section of the tank takes the water from the boiler; the other section of the tank takes the steam from the boiler. The water is perfectly clean and they put it into the boiler at a higher temperature than a man can handle it in washing out, and in a short time you have steam with which to fire up the engine. We wash out entirely with a pump. In addition to having the steam pipe going around the shop for the purpose of blowing steam into the tank, you can also have connections made with your engine, so that you can take advantage of an incoming engine to assist an outgoing engine. You can use the steam from an incoming engine, putting on the blower, etc., to help an engine going out. In addition to the steam being put in the tank from the boilers, all of the exhaust from the pumps from your stationary engine, after the water has been put through a superheater, the exhaust for the purpose of feeding your stationary boilers, all the water from



Ten-Wheel Passenger Locomotive for the Central Railroad of New Jersey.



Tender.

Type	8-wheel
Tank capacity for water	5,000 gal.
Coal capacity	10 tons
Kind of material in tank	Steel
Thickness of tank sheets	¼ in.
Type of under-frame	Steel channel
Type of truck	Metal, R. R. Co.'s standard
Type of truck spring	Triple elliptic
Diameter of truck wheels	33 in.
Diameter and length of axle journals	5 x 9 in.
Distance between centers of journals	65 in.
Diameter of wheel fit on axle	6⅜ in.
Diameter of center of axle	5⅜ in.
Length of tender frame over bumpers	21 ft. 1½ in.
Length of tank	19 ft. 6 in.
Width of tank	10 ft.
Height of tank, not including collar	5 ft.

the drips from the steam pipes for heating the shop and from the pumps is put back into these hot water tanks to assist in the heating of water for washing out the engines.

Mr. F. M. Whyte (N. Y. C.)—How long does it take to blow down an engine when the steam from one boiler is used to build up the steam pressure of another boiler, and also to blow into the tank? How long does it take to blow down the pressure from the locomotive boiler, either blowing into the tank or blower pipe of another locomotive boiler?

Mr. Robb—I cannot say how long it takes to blow from one engine to another, but we can take an engine into the shop and wash it out thoroughly in three hours.

Mr. Wilden (C. R. R. N. J.)—I ask the gentleman what size pipe he uses in connection with the roundhouse for blowing off the engines? I understand you have one pipe for water and one for steam.

Mr. Robb—We use a 3-in. pipe in both cases.

Mr. Angus Sinclair (Loco. Eng.)—You can count the strata in the scales in the boiler, which show the number of times that the boiler has been blown off. A great quantity of the impurities coming from the water floats on the surface of the water in the boiler, and when the boiler is blown off hot, the scale settles upon the heating surfaces and becomes hard scale that cannot afterwards be washed out. I know the Association has urged repeatedly that no engine should be blown off while it is hot, that is, it has been recommended that the steam be blown off and that the boilers be gradually filled up with water and that the reduction of temperature should be obtained as slowly as possible. Every one knows that treatment of that sort is easier on the sheets than if the boilers are blown off hot, especially with a hot brick arch which takes a long time to cool down.

Mr. J. Christopher (T. H. & B.)—I ask Mr. Robb if it is his practice to use the pressure from an incoming engine attached to the blower pipe of the engines being fired up after washing. Does his experience lead him to believe it is good practice. Does increasing the heat in that rapid manner give the sheets time to assimilate conditions? Is it not equally injurious to a boiler to heat up too rapidly as well as to cool down too rapidly? I understand he attaches the steam blower-pipe to his engine which has been just washed out, to facilitate getting up steam quickly. I ask him if I am not correct in assuming that there is some danger of injury to the sheets in this practice?

Mr. Robb—You can put the blower down your stack. It goes down the stack the same as your fan blower in the smoke-box. Blow it that way or attach an injector steam-pipe to the pipe, and put the steam right into the boiler. When you start to wash with hot water, you keep the smoke-box closed when you are letting out steam, not water, and only have it opened when washing out. The idea is to keep the boiler as hot as you can from start to finish. I have been using hot water in washing out for 18 years. Previously we washed out with cold water, running the water through the boiler, opening the blow-off cock and letting it run through so many hours so as to get the boiler cold before you washed it. At the present day the exigencies of the service will not allow that to be done, as you have to get the engines out in a hurry; and I have yet to find, after 18 years' experience, any injurious effects from washing out engines with hot water. Of course, you have to see that your washer does not open the engine up and wash out with cold water, when he should be washing out with hot water.

Mr. Robert Miller—We all realize the importance of avoiding delay as much as possible in the washing out of boilers. Our practice is to open the blow-off cock when the boiler is to be washed out, before the engine goes into the house, and from the blow-off cock, blow out the water and carry off in that way as much of the sediment as is possible. We find in the frequent blowing off of boilers that we carry away a great deal of loose sediment; and in order to avoid the accumulation in the boilers of mud and sediment, we have put on blow-off cocks on our locomotives so that the boilers can be blown out at the terminals at the close of each trip.

Prof. H. Wade Hibbard (Cornell Univ.)—So far as I know, there is not a single roundhouse in this country that carries out the idea of having the greatest possible amount of daylight admitted through the exterior walls.

Mr. W. O. Thompson (N. Y. C.)—I agree with Prof. Hibbard that you cannot get too much light in the roundhouse. I think it is advisable to have as many windows in the walls as can be put there.

Mr. M. N. Forney—In past years I have had occasion to travel through the country and visit railroad shops in many places, and it seems as if the designers of railroad shops always took the greatest pains to exclude daylight. It may be laid down as a maxim, in roundhouses or work shops of any kind wherever men are employed, that you cannot admit too much daylight, provided you can exclude the sunshine. The largest possible amount of window area is important, and furthermore you will find very often that in shops that the architect or the person who designs the shops takes pains to exclude the light from the upper portion of the building. The light from the top is more desirable to work in than that which comes from the lower part of the window. Therefore, there are two principles which may be laid down without hesitation, and that is to get the largest possible window area in the walls, and the other is to carry the windows up as close to the ceiling as possible.

Mr. T. A. Lawes (C. & E. I.)—I submitted to the Committee on Up-to-Date Roundhouses last year a plan of a roundhouse in which the outer wall was all glass and steel. The roof portion was on I-beams, and in the interval between each I-beam the space was filled with glass, no brick in it.

Mr. McIntosh—The Central Railroad of New Jersey has built two roundhouses during the past 18 months, and in both we have arranged to do just what has been suggested as desirable, that is, provide as much light in the outer walls as possible. I should say that nearly 35 per cent. of the wall is windows.

Mr. Quereau—As to the matter of time required to blow off a boiler, I will say that a 60 to 62 in. boiler can be blown off out of doors through a 1¾ in. blow in 35 minutes, down to 20 or 30 lbs. pressure, at which time the pressure is supposed to be sufficiently low to fill the boiler with cold water.

Mr. Whyte—How will that compare with the blow-off pipe, 3, 4 or 5 in.?

Mr. Quereau—I cannot say how that will compare with the blow-off pipe of 3, 4 or 5 in. diameter, except in one case, that of a 4-in. pipe, to which I alluded, the length of time required to blow off was lengthened from 15 to 20 minutes compared with the time required to blow off out doors. We had to abandon it during the rush.

THE COST OF RUNNING TRAINS AT HIGH SPEED.

The President—One subject on the programme yesterday was partly considered, and was left over for consideration to-day—the Cost of Running Trains at High Speed.

Mr. McIntosh—The results of the test mentioned in the appendix show an increase of about 50 per cent. in horse-power to move the fast trains. The increase in average pounds of water is about 25 per cent.; the increase in the average pounds of coal is about 20 per cent.; per ton-mile is also shown. The difference between the coal and water can be accounted for by the fireman allowing his fire to run down somewhat when closing a fast run.

The President—We will now take up the report of the committee on "Present Improvements in Boiler Design and Best Proportions of Heating and Grate Surfaces, for Different Kinds of Coal."

IMPROVEMENTS IN BOILER DESIGN AND BEST PROPORTIONS OF HEATING AND GRATE SURFACES.

[*See the Railroad Gazette, June 27, page 492.*]

Mr. F. F. Gaines, of the Lehigh Valley, read the paper and said: I have had my attention called to the omission of some of the recent engines in this paper. I am sorry for it, and my only excuse is that no person could go over the technical papers for several years past without the risk of overlooking a few engines that ought to be included.

Mr. David Van Alstine (C. G. W.)—Referring to the first recommendation of the committee that we give the relation between the indicated horse-power and the total heating surface, it seems to me that relation cannot be a constant throughout the country. On roads where bad water is used they must allow more heating surface per indicated horse-power than on roads with good water, and if that is true in this case, it will also be true of recommendation No. 2, that the bad water district must have a greater weight of engine per given horse-power to make a satisfactory boiler. I think it would be a good plan, in case this committee is continued or a new one appointed, to ask the committee to include in its report such information as it can obtain, showing the weights of boilers of different horse-power; that is, what percentage of the total weight of the engine the boiler is, and what percentage the machinery is, and then we can see how much the boiler weighs per indicated horse-power in bad water districts and how much in good water districts.

Mr. Gaines—I might refer Mr. Van Alstine to Plate 1, Fig. 1, under the heading of "simple passenger engines." These engines cover pretty equally the whole United States, bad water districts and good water districts, and in the uniformity, and in the narrow limits given for that ratio, seems to show that the thing lies in a pretty well defined group all over, irrespective of the kind of service and where it is used. Take a simple passenger engine and the limits are very narrow between which these constants vary. Referring to Plate 13, for weight of simple passenger engines, you will observe the total number of engines plotted fall within a narrow limit, and the variation is much smaller than one would be led to expect. While there is some variation due to local conditions, yet as a general comparison it will not be found to vary as much as might be expected.

Mr. C. A. Seley (C., R. I. & P.)—In view of what Mr. Van Alstine said, it seems to me that the good-coal and bad-coal districts would be more important than the good-water and bad-water districts, and Mr. Gaines points out the actual limits covering the practice in good and bad coal districts, as well as good and bad water districts, and it seems to me it would be an endorsement of this plan by plotting the ratios. The ability of a boiler to generate steam depends on the utilization of heat units in the coal and not so much on the water made into the steam. Bad water will affect the work of the boiler if it is scaled up to a certain extent, but primarily and all the time it is a question of coal.

Mr. Gaines—I have taken the stand in this matter, and I think you will see that I am right, that the heating surface is independent of the quantity of fuel and water used. You must have a certain amount of heating surface to evaporate the water, and that is independent of the amount of coal consumed. The coal question is covered by the grate surface and if you will refer to page 6, you will find there is much latitude given for the different kinds of coal in regard to the ratio between heating and grate surface; and the proposed series of curves which I am to put in relation to the power and grate surface will cover the point in question.

Mr. F. M. Whyte—Would Mr. Gaines make a correction in recommendation No. 1, to confine the proposition to simple locomotives?

Mr. Gaines—I considered the compound locomotive in this way: Take the gross tractive power of the compound locomotive, and the formula of tractive power of the simple locomotive and then solve for the equivalent cylinder diameter of the small engine of the same power; then treat the engine as a simple engine in these comparisons. That is what has been done all the way through with the compound engine.

Mr. Whyte—You take it for granted that the compound locomotive is properly designed and has sufficient cylinder power for the weight on the drivers?

Mr. Gaines—If the engine is not properly designed, it will show up in the ratios. An engine over-cylindered would give a very low ratio of weight to horse-power.

Prof. W. F. M. Goss—I am interested in these ratios which are given upon page 4, for the reason that in estimating the power of certain engines some months ago I used the value of 2¼ sq. ft. of heating surface for 1 h.p. Mr. Gaines gives 2.39 for the passenger engine and 2.3 for the freight engine, which is in practical agreement with the values which I chose. Since the publication of the work to which I refer, it has been subjected to some criticism, the claim being that my estimate of the power of certain engines is in excess of what they are capable of giving, one critic claiming that they were at least 50 per cent. too high. I think it is true that many of our large engines which are in every day service give results which will fall far below those intimated by Mr. Gaines's ratios as well as by the ratios which I employed. But I do not think that such service measures the capability of a large engine, and so I think Mr. Gaines is correct, and that I was reasonably correct in the values which I chose, because when the large engine is put to the same intensity of action that small engines are constantly being worked at, then we shall find they will give results comparable to those presented in the report. The fact is, the large engines are not being worked so hard, because it is not possible to fire them except at short intervals, when the firing need not be continuous or proportionate to the work which the engine is performing. In accelerating trains, getting out of stations, etc., the large engine is worked to its power, and at slow speeds the large engine is worked to its full power, but they are not as a rule in continuous service, being worked to their full power, because we cannot supply the coal to them. The effect of this comment is intended to be in accord with Mr. Gaines in the value of these ratios which he has presented. I think they are borne out by such data as I have been able to produce in study.

With reference to one detail, the use of the symbol "i.h.p.," I should prefer to see that symbol confined to measures of power as actually obtained from the indicator. I think it is a mistake to call a value "indicated horse power," when it is not obtained by means of the indicator, and when it is really an estimated power. In a previous discussion of the matter I have been careful to use the symbol "c.h.p.," cylinder horse-power, which cylinder horse-power is assumed to be the equivalent of the indicated horse-power, but a measure which was not arrived at by means of the indicator, but in some other way.

Mr. George W. West—The road with which I am connected built some 100-ton engines, and our experience endorses fully what Prof. Goss has said. When we first obtained the engines we used them entirely in the pushing service and they came up to our expectations and fully developed the power represented by the ratios. After we had a sufficient number of the engines to use them on a division of 150 miles, we could not get the results as in the pushing service, from the fact that they could not be kept hot.

Mr. H. H. Vaughan (Lake Shore)—I will call attention to the fact that this report recommends a new ratio between heating surface and horse-power, superseding the recommendation of the 1897 report, which was the ratio between cylinder volume and heating surface. The 1897 report contained a large amount of information, and if this ratio is adopted we shall have two ratios running, the one being indicated horse-power to heating surface, and the other being the ratio between cylinder volume and heating surface as in the 1897 report. If you will look at recommendation No. 1, here presented, you will find the method recommended by this committee is identical with that adopted by the 1897 committee; in other words, the size of the driving wheels is eliminated, because we are considering a certain number of revolutions per minute in this report as was considered in the 1897 report. The one fact different in this report is the question of boiler pressure, and as this question is of very doubtful correctness, as we do not at present know enough about the efficiency at different pressures to say whether they should be a factor in this quantity, I think it is a mistake to change from the ratio that was established in 1897, and practically do away with all the information in that report. This is introducing a new ratio. The old one was that of cylinder volume and cubic feet of heating surface. It might as well have been the diameter of cylinder squared multiplied by stroke, or anything else when a certain ratio is established. This is introducing a new ratio practically, and I do not think there is any advantage in so doing. It is no more a measure of the horse-power than the old method.

(Vice-President West in the chair.)

Mr. M. N. Forney—The paper before the Association brings up a subject I remember having discussed many times during the past 30 years, and more; and I can recall a paper on somewhat the same subject which was read quite a number of years ago, which caused a discussion similar to this, except at that time we had not so many members of the Association who had received the advantages of a technical education. There was a formula proposed to give the proportionate heating surface to the power, weight and capacity of the engine. After the discussion had gone on some time some one said there was a simpler formula than the one proposed to determine the amount of the heating surface, and that was to make the boiler as large as we can; and the principle might safely had been laid down that, between the limits of weight and space to which you are confined, you cannot get a boiler too big. I believe that is a sound principle, and the question that is brought up to-day in this paper is the relation of the grate surface to the heating surface, and the new forms of construction which have come in, wide fire-boxes, makes it possible for us to proportion the grate to the heating surface, whereas in the old forms of engines, where the fire-box is placed between the wheels or between the frames, it is not possible to get as much grate surface as we might desire. My attention was called to this subject some years ago and it seemed to me that the matter of grate surface stood somewhat in this way: That when an engine is worked very hard, you need a great deal of grate. When the engine is not worked so hard you do not need so much grate, and, therefore, that the live portion of the grate should be adjusted to the work which the engine has to do.

Mr. A. M. Waitt (N. Y. C.)—I have been giving quite a little thought and study to the figuring of ratios of heating surface to the power developed by engines, and I was much interested the other day in looking over the detailed dimensions of quite a number of locomotives; and although many of these locomotives were designed and the heating surface proportioned quite closely to the formula laid down in 1897 and a great many locomotives have been designed since that time, yet I know as an actual fact that many engines designed on the basis of that formula are poor steamers in service. I have been tracing this along to see if I could get at any way of avoiding the difficulty that others have run into. I do not know that I have, but I know that there is a radical difference in some engines that have been built by several roads during the past year and a half, in the fact that though the weight on drivers is practically the same as those designed by other roads, yet they steam well in service, they take the trains over the road, work hard or easy, and still have an abundance of steam, with the fireman not overworked, but having plenty to do, because with the large engines, no matter how wide or short the fire-box, the fireman is closely to the limit of what he can do. Yet in the case of the other engines I speak of, designed apparently in accordance with the formula in the 1897 report, they do not steam. What is the difference? I find in looking over this table that I referred to a moment ago, that there is a very great difference in passenger engines and in freight engines in the ratio between what I consider as a fair indicator of the power of the engine, that is, the weight on the drivers. Whether tandem-compound, four-cylinder compound, simple engine, or anything else, always the weight on the drivers indicates the maximum power you can get out of the engine. It does not require any figuring or algebraic formula or anything of that kind to show that the weight on the drivers is the basis of the power you are going to develop. How are you going to get the power? You must have the steam. It seems to me if you take the ratio of these indications of the power to be obtained from the engine, the weight on the drivers and the heating surface of the boiler, these two features give the keynote to the situation and give you just what you want to arrive at. On passenger engines I find in this list that the ratios are running all the way from as high as 1 to 54.9, down to as low as 1 to 27. That is quite a variation, and it is certain that there are a number of these engines which when put behind heavy passenger trains, cannot make the steam and get the train over the road. There are others of them where the ratio is lower, that you can put behind an eight or ten-car train, and they will go along and be popping off when they are doing their very hardest work. It seems to me it is worthy of consideration whether there is not a simpler way of getting at the formula necessary for determining how much heating surface you want as compared with the weight on the drivers, which indicates the maximum power you can get out of the engine. I found the best ratio in any engine was 1 to 27. These engines are steaming admirably, whereas engines in the same service with a ratio of 1 to 45 cannot furnish the steam to do the work. In other service we require an entirely different ratio. With our freight trains we are taking 10 hours to travel 150 miles, whereas in passenger service we are doing it in three hours, and you must furnish steam in less time with passenger engines, so that with freight engines the ratio of the heating surface to the weight on the drivers can be higher.

Mr. Gaines—Where you have an engine to design, that must perform a certain amount of work, such as hauling a given train over a given division, where the grades and weight of train are known in connection with a limiting driver weight laid down by the maintenance of way department, it is absolutely necessary to know the limits within which you must work in order to produce satisfactory results. If you have your boilers and cylinders designed to suit what you think the occasion demands, you may find it to exceed your weight, and that it is necessary to cut down the size of your boiler. If you know the limiting values of heating surface that can be used successfully, you have an option on two courses: You can either cut down the heating surface to a point at which you know from previous experience and derived ratios the boiler will not generate sufficient steam, and the other alternative is to admit that the problem is impossible under the limiting circumstances.

Another question, which Mr. Waitt brought up, was in regard to the '97 machines, that they have undoubtedly fallen behind what is modern practice. Naturally at that time, the ratio of grate areas and heating surfaces were not what they are to-day. I would ask Mr. Waitt where you are preparing the amount of heating surface in relation to the weight on drivers, is not that apt to be deceptive when you come to engines with the traction increaser on them?

Mr. Waitt—I neglected the traction increaser entirely, because that is used in starting trains when you are not furnishing steam rapidly. At high speeds the steam is furnished rapidly and then the traction increaser is not used.

Mr. Quereau—I move that the discussion on the report be closed without further action. (Carried.)

The meeting then adjourned at noon to enable its members to visit the Schenectady plant of the American Locomotive Works.

Third Day's Proceedings.

The convention was called to order at 9:30 a.m. The Secretary has some communications that we will take up.

The following resolution was presented by Mr. C. H. Quereau:

Resolved, That in view of the close relations between the American Railway Master Mechanics' Association and the Master Car Builders' Association, both in their aims, influence, personnel and place and time of meeting, and the very important influence of this Association on the safe and prompt movement of traffic, we suggest that a continuance of free transportation to and from our yearly conventions is worthy of careful consideration by the various passenger traffic associations; therefore

Resolved, That the Executive Committee of the American Railway Master Mechanics' Association communicate with the passenger traffic associations and ask their consideration of our claims.

(Adopted.)

THE PRESIDENT'S RECOMMENDATIONS.

Mr. R. D. Smith—Your committee appointed to consider the recommendations in the President's address beg to submit the following report:

First—We believe the President's recommendation that the ratio of the weight on the drivers to the heating surface, as a basis of judging good practice in locomotive design, is well thought out, simple and worthy a committee to report at the next convention. We would therefore recommend that such a committee be appointed.

Second—The suggestion of the President as to extending the usefulness of the Association, by inaugurating tests and experiments affecting locomotive performance, to be carried on by trained experts under the direction, or supervision, of committees of this Association and assisted financially from the funds of the Association, is favored by this committee and we recommend it be carefully considered by the Executive Committee in mapping out the work for the coming year.

We believe the usefulness of the Association in this direction would be materially increased, if its membership was placed on a representative basis, on lines similar to those of the Master Car Builders' Association, and recommend that the Executive Committee consider the matter and report on it at the next convention.

Third—The recommendation of the President as to the appointment of a committee on revision of the standards, recommended practice and standing resolution, is without question a good one, and we suggest to the Executive Committee that such a committee be appointed.

Fourth—In reference to the recommendation to appoint a standing committee to report to the Association on "the progress of the year," embracing improvements in locomotives, shop practices, new machine tools, etc., it is thought there is a field for such a committee and we would recommend that it be appointed by the Executive Committee; that in the selection of this committee care be taken to include in its personnel members whose observations will cover the widest possible range, and who will bring new principles and methods before the Association for discussion.

Fifth—The suggestion of the President that more individual papers be presented is timely and is thought to be worthy of further extension. Your committee recommend that this suggestion be acted on by the Executive Committee.

Signed by R. D. Smith, Peter H. Peck, Wm. McIntosh.

The report was accepted and recommendations adopted.

STANDARD SPECIFICATIONS FOR LOCOMOTIVE DRIVING AND TRUCK AXLES.

[*See the Railroad Gazette, June 27, page 493.*]

There were none of the committee on this subject present, so the Secretary read the report, which was then declared open for discussion.

Mr. Gaines—I agree with the remarks of the committee and think there is no question that the specification for driving axles should disregard car axles, and include engine truck axles, crank pins, rods, guides and other locomotive forgings. As to the specification itself and methods of testing, it would seem that the specification does not cover the matter entirely. The question of annealing is entirely disregarded, as well as that of oil tempering. Users of high grade steel are beginning to recognize the value of heat treatment after forging. Another point is the method of taking test specimens. Where a specimen is taken from one end of an axle or bloom only, the test is far from conclusive. I know of driving axles furnished by different manufacturers where one end of the axle would give normal wear while the other end wore so rapidly that it was worn below the limit before the opposite end had a $^1/_{16}$ in. wear. Upon etching sections of such axles they show that one end has not been worked. Specification should cover this point.

While driving axles are purchased in small lots, many roads may deem it extravagant when buying from six to 10 axles at a time, to cut one up for test, and it is suggested that the specification should cover this condition also. It might be done by having an extension left on each end of one forging in a lot, or on all forgings, from which tests could be made. Or if this method is undesirable the axles could be used without testing, and in case of fracture or undue wear a test to be made in the regular manner. If the results show a material below the specification, the manufacturer to replace the forging. The latter would require the keeping of an accurate record of the manufacturers' heat number.

The President—The committee recommend that the subject be continued another year, and that a representative from each of the locomotive companies be added to the committee.

Mr. P. H. Peck (Chicago & Western Indiana)—I move that the recommendation of the committee be adopted so far as reporting the progress, and being continued, in addition to the representatives of the locomotive companies being added. (Adopted.)

Mr. Whyte—I make a further motion that they be invested with the necessary power to co-operate with the International Bureau of Tests. I move that they be given such authority. (Carried.)

HELPING ENGINES.

[*See the Railroad Gazette, June 27, page 494.*]

The President—The next report is an individual paper on "Helping Engines and Their Performances" by Mr. F. F. Gaines.

Mr. C. H. Quereau—So far as appears from the paper only the advantages of double-heading have been called to your attention, and it is double-heading as usually understood rather than pusher-engines or helper-engines that I am now discussing. It occurs to me that only the credit side of double-heading is mentioned. There is also a debit side and the debit is frequently very high, under certain conditions, so high as to make it very doubtful if double-heading pays. I have in mind a road which undertook to double-head as an economic transportation proposition, but the practice was abandoned after a comparatively short time and the reasons will appear from what will follow. A very large proportion of the freight cars are built for locomotives having a tractive power of from 20,000 to 30,000 lbs. Those cars are still in service, and when a locomotive of from 30,000 to 40,000 lbs. is used or when two locomotives having a combined tractive power of 70,000 lbs. are used, it is very easy to see that there are large chances of considerable damage being done to the cars. The chief reason in abandoning double-heading on the road that I mentioned, was the excessive number of cases of break-in-twos and damage to draft rigging, not only the immediate damages from the breaking in two but the consequential damages throughout the train.

It happened six or eight months ago that I was in charge of a road test of locomotives. The locomotives were of large size and the trains long and heavy. There were a number of break-in-twos during this test, over 75 per cent. of which I believe could be charged justly to the large size of the locomotives and in the majority of these break-in-twos the train was separated at more than one point. The delays were numerous. When we have all-steel cars or steel center sill cars, with friction draft rigging or strengthened draft rigging, the matter of double-heading will assume quite a different aspect, but we must for the present consider it under present conditions.

Another objection to double-heading is the long delays in getting over the road involving laying at side-tracks, additional fuel expense and that of additional expenses on account of overtime. I have in mind a district 95 miles long where double-heading trains frequently required from 21 to 26 hours to pass over that district. To be sure, this was in a time of very heavy traffic, and when one considers that overtime usually begins at the expiration of 10 hours for engine and train crews, it can readily be seen that there is a large debit to be placed in this double-heading account. In this connection I wish to suggest for consideration the thought that under such conditions as I have indicated, namely, heavy traffic, comparatively short trains and speeds are more economical than long trains and double-heading. I think that is well worthy of investigation. During this

test to which I refer, which was not during the season of heaviest traffic, we frequently lay on side-tracks from a half an hour to an hour and a half, simply because the train was so long and it took such a length of time to get it up to speed that we could not go to the next station. If we could have made the time from one station to another in anywhere from three to five minutes less time than the weight of the train made it necessary to take, we would have gone.

Another debit is that it requires at least twice the time and usually more than twice the time to take coal and water and clean the ashpans with two engines, as compared with one. Another matter is hot bearings. I believe that the number of cases of hot bearings in double-heading is much greater than where but a single engine is used. This is particularly true if the speed is anything more than that of a maximum tonnage freight train, these hot bearings usually appearing upon the second locomotive. I know of a case where the practice of double-heading on passenger trains was very largely, although not entirely, abandoned because of the delays due to hot bearings on the second engine, because of the dust and dirt stirred up by the head engine.

Another feature not on the debit side but worthy of consideration in connection with double-heading is the design of the cabooses. If the caboose platforms are not of sufficient strength to withstand the power of the pusher engine, the way-car is cut off and the pusher-engine placed next to the train with the way-car behind it. This is standard practice on a good many roads. The Santa Fe is leaving off the end platforms and using a side door; some other roads are extending the main sills of the car through the platform, making the framing continuous from one end to the other. There are a great many advantages in having platforms and the use of the framing including the platform will make the way-car as strong as any other car in the train.

A matter called attention to by Mr. Gaines, well worth emphasizing in commendation, is the matter of the diameter of the driving wheels for engines to be used not only as pushers on grades but applicable to all power to be used on railroads having unusual grades. I am satisfied that the driving wheels for railroads situated as those I have indicated should be larger than the usual practice is. I call to mind one road on which the outside diameter of the driving wheels, until a comparatively few years ago was 48 in. The engines gave excellent service in going up hills, but in getting from one end of a division to the other they were not in it with locomotives having larger drivers. The consequence was that a 2-in. tire was left on the wheel center and made a part of the wheel center and the tire placed outside of that, increasing the diameter of the drivers 4 in. And about two years ago the driving wheels of a standard freight locomotive was increased from 48 up to 55 in. with very good results. The power of the locomotive, which was taken away by increasing the diameter, was made up by a larger cylinder and increased steam pressure.

On the fifth page you will find the sentence: "As the water evaporation is heavy, a good inlet from tank to injector should be provided." I do not wish to be understood as advocating a small inlet for the water, but the reason given here it appears to me is not particularly applicable to these conclusions, because the high duty in evaporation occurs not at slow speeds but at high speeds. It is our passenger and fast freight locomotives on which the injector fails to supply the water, simply because at high speeds a greater amount of steam is demanded in a given length of time, although the total amount of steam used per revolution is considerably less.

Mr. West—I did not understand Mr. Gaines' paper to be on double-head engines. There are many roads, especially Mr. Gaines's road and the road which I represent, which are located in a district that makes it necessary to use helping engines. We are not troubled with long trains. It requires three 100-ton engines to move 50 cars over our grades. It is to cover these points that I understand Mr. Gaines's paper was prepared.

Mr. David Brown—Where you have got to go any distance beyond the hill, I am not in favor of the helper engine being either ahead or behind. Now on the road that I am connected with we have a very serious problem to contend with on a certain part of the road. Starting out of Scranton it takes four engines to take a train eight miles up the road that one can take from a point 48 miles up the road, and it takes two engines to take it from the eight mile point to the 48 mile point. If the train was so arranged that one engine would be ahead and the other about 40 cars back, leaving about 40 cars for the second engine, and if the first engine had control of the air-brakes of the first 40 cars, it would control the train for what grades had to be descended or any ordinary stops. The second engine, if connected up with the brakes behind it, could be used for an emergency, or if anything happened to the other engine.

Mr. C. A. Seley—There are many roads in which double-heading is not proper. On the road with which I am now connected traffic is mainly fast freight stock movement, and the cars run in a section of the country where fast double-heading results in hot bearings on the second engine; consequently the practice is very much restricted and is confined to but a few points. On the contrary, there are numerous roads in the country where double-heading is extensively practiced, and where pushing engines are also an additional means of getting trains over the road. In this connection I have in mind a point on the Norfolk & Western where three-engine trains are the rule.

The point as to the location of way-cars on these trains is an important one. When you put a 23 x 32-in. or a 25 x 32-in. cylinder engine behind a way-car, it is sometimes the case that these four-wheel cars are lifted off the rails, particularly with the present vertical plane coupler.

Mr. Gaines—I do not wish it to be understood that I am an advocate of the double-heading under any and all conditions; but I would like to bring out one condition where it seems to me it is justifiable to double-head. You have a piece of track where your bridges are light. Perhaps the bridges will not carry an engine weighing from 85,000 to 90,000 lbs. on drivers. That is not unusual on some of the branch lines, and the branch lines at the same time may contribute a very heavy traffic. Two engines of 20,000 lbs. tractive power each would be 40,000 lbs. tractive power sufficient with numerous trains.

Referring to the question of cabooses, I think Mr. Quereau's remarks are in the right direction. We are building some cabooses at this time in our shops with a heavy steel underframe running from end sill to end sill of platforms, practically making a continuous backbone between the couplers.

We have engines which evaporate 7,000 gallons of water in a little over an hour, and I think that means pretty good water connections all the way through. They are in the pushing service, too.

In regard to large and small diameter of driving wheels, I am willing to admit that a small diameter of driving wheel, where you are exerting the utmost power has more uniform movement and is a little more powerful. On the other hand, I think the wear and tear of the engine sufficiently offsets that to make it advisable to use a rather larger size of driving wheel. I would say I personally would not want a driving wheel under 50 in. outside of the tire.

On motion the discussion was closed.

STANDARD PIPE UNIONS.

The President—The next report is that of the Committee on Standard Pipe Fittings.

Mr. Quereau—Practically the same report was made last week by the committee of the Master Car Builders' Association. The action of that Association was that the committee be continued for another year with the hope of getting information, and by consultation and correspondence with the various manufacturers of pipe unions, secure their co-operation in adopting this standard; and I believe that is the wisest course of action for this Association to pursue.

On motion the report was received, the committee continued another year and instructed to conform to instructions issued to a similar committee of the M. C. B. Association.

TOPICAL DISCUSSIONS.

Piston Versus Slide Valves in High-Pressure Engines.

The discussion was opened by Mr. F. H. Clark.

Mr. F. H. Clark (C. B. & Q.)—Our experience with piston valves in locomotive service dates back to 1895 when we ordered a Columbia type engine with 19 x 26 in. cylinders and 84 in. wheels for fast passenger service. This engine had piston valves 9½ or 10 in. in diameter, a 6 in. maximum valve travel and 1 in. lap. The packing rings were rectangular in section and about $^7/_{16}$ in. wide.

In the following year we applied piston valves to a slide valve mogul engine by substituting a valve cage and valve for the steam chest and slide valve previously used.

We did a good deal of experimenting with both engines and finally reached the conclusion that we would make no mistake in building engines with piston valves. We now have about 150 of these engines on the Burlington system, exclusive of four cylinder compounds and nearly as many more ordered for delivery in the next eight or nine months.

The principal advantages of piston valves result from the fact that it is so nearly balanced that the friction is reduced, and this of course means less friction springing and wear in the eccentrics, links and other parts of the valve gear, and power saved for useful work. Tests made in 1896 on the 19 x 24 in. mogul engine fitted with piston valves seemed to indicate that the friction was less than one-half as much as with slide valves.

The first 50 or more piston valve engines that we built had 19 x 26 in. cylinders and 10 in. valves, but these valves were considered to be pretty close to the limit in size, except for switch engines and on more recent road engines with cylinders 20 x 24 in. and larger, 12 in. valves have been used. The packing rings are all of the L section with ⅝ in. outside bearing, ¼ in. projection and varying depth. These rings give better satisfaction than the plain rectangular ring though perhaps they are somewhat less durable. Although on the whole I think the piston valve may be said to be fairly established, there is room for improvement both in design and practice. There seems in some quarters to be a tendency to expect too much of it and to fail to take the same care in fitting up and in renewals that all expect to give to slide valves. I believe we can well afford, if necessary, to give it even more attention than our slide valves demand.

The Secretary read a communication from Mr. Charles M. Muchnic:

It is well known that with the ordinary slide valve, when there is an accumulation of water in the cylinder, the piston in its movement forces the water through the ports to the valve seat, which in turn lifts the valve from its seat and lets the water pass into the steam chest. This will also be true for any excess pressure on the piston and head that may take place at the end of a stroke. With the piston valve the valve sets solid in the bushings and will not admit of any water or steam to pass over from steam port into steam chest when that port is closed by the valve.

To provide against this the builders of the first lot of our piston valve engines (in 1897) have provided each cylinder head with a 2 in. "knuckle" pop valve set a few pounds above the boiler pressure. These relief valves have given in service considerable trouble from leakage, or otherwise, with the result that they were taken out, the holes plugged and the engine run for months without relief valves.

The blowing out of cylinder heads with this class of engines became rather frequent, and it being mostly the forward cylinder head, it was thought that it lay in the weakness of the head. These were consequently reinforced but the trouble still continues. Some of the blown out cylinder heads have relief valves in them.

It occurs to me, therefore, that the blowing out of the cylinder heads is largely due, if not wholly, to the inability of the piston valve to lift itself from its seat as the slide valve does, and to a faulty design of the cylinder relief valves in perhaps not having sufficient aperture to relieve instantaneously the excessive pressure that is brought to bear upon the cylinder head and piston equally. What this pressure will be will depend on many variables and would be hard to calculate. However, we can know approximately what this is by finding out what force it will take to rupture the head at its weakest point.

The normal pressure on cylinder head of a 20 in. diameter cylinder at 200 lbs. pressure would be 62,832 lbs. To rupture the cylinder head in question at the weakest point would take an estimated force of about 660,000 lbs. Suppose that the cylinder heads were made of proportions large enough to withstand with safety such an enormous stress, we would also have to increase the proportions of our rods, pins and other parts of the engine frames to equally withstand this maximum stress, the pressure being transmitted equally in either direction.

It may also be well to mention here piston valves that have come under my observation and so designed as to answer the purpose of the relief valve or the lifting of the slide valve.

These valves with which the members may be acquainted are the Ricour piston valve as used in France for many years with fair success, and the Smith valve as used on several roads in England with equally fair success. In the Smith valve it will be noted the packing consists of one complete ring of the ordinary type, and a second ring made in three distinct segments. The points of these segments come on the bars across the port openings. Steam is admitted behind the segments so that each constitutes a sort of slide valve by itself. The valve thus acts as a relief valve in case of the water reaching the cylinder. The segments then yield inwardly and the water gotten rid of, return to their seats. The "Ricour" is similar in action but simpler in construction—it having but one packing ring.

Mr. George W. West (New York, Ontario & Western)—I ask Mr. Clark if any of the divisions over which these engines are operated have any considerable opportunity to coast or run without steam.

Mr. Clark—We perhaps do not do so much coasting as is done in the East, but we have occasional stretches of 8 or 10 miles over which the engines run down hill without steam. I do not know that we have any difficulty in lubricating the valves, but we find on some engines that if we let the reverse lever down in the corner, the valve motion will make trouble; but, on the other hand, we do not want it too near the center. I think in the position that would give us 60 to 75 per cent. cut-off, we have no immediate trouble with the piston valves.

Mr. Quereau—I have had some experience with piston valve locomotives, for something over two years, and in one case they drift 62 miles using steam only in going out of the stations. The grade is not very steep, except for a third of that distance, but it is sufficiently so that trains will make time card speed, about 34 or 35 m.p.h., without the use of steam. If the reverse lever is placed in such a position as to give approximately 50 per cent. cut-off, there is no difficulty in the jerking of the reverse lever and no wear on the valve gear more than ordinarily. But that possibly would apply only to the design of piston valve with which I am familiar. I have heard the same statement made on a number of other roads that there is a position of the reverse lever where there is no unusual jerking. I am very favorably impressed with the piston valve, not only from theoretical considerations, but in practical service, and it is a fact that at the highest speeds, with the wide-open throttle, they can be handled, if properly designed, easily with one hand.

Mr. C. A. Seley (C. R. I. & P.)—I would ask some of the speakers who have had experience with the piston valve whether it is advisable to have a hollow valve. As most of the piston valves are inside admission, the exhaust is discharged into the ends of the chamber and there is a considerable recoil, particularly when the engines are running slow and the exhaust sounds of these engines are very sharp. You can generally tell a piston valve engine without seeing it. The practice of the Norfolk & Western Road has been mainly in the direction of solid valves, although some experiments have been made with the hollow valve with a view to the possible softening of this recoil.

Mr. G. A. Hancock (St. L. & S. F.)—An 18 x 24 in. engine, carrying 180 lbs. of steam, making 10,000 or 12,000 miles per month, was fitted with a piston valve

without packing rings, in place of the ordinary slide valve. At the end of six months the valve was examined and the wear was hardly perceptible. Similar valves were furnished for the tandem compound and at the end of three months a test was made with a simple engine of same capacity, and it showed a saving of 18 per cent. in fuel, which demonstrates that there is very little waste on account of valves wearing and blowing. The compound engines are provided with relief valves and there was no trouble with engines drifting. No relief valves were furnished with a simple engine. We decided there was very little advantage in the use of the piston valve other than that it can be handled easily.

Mr. F. F. Gaines—I have lately had some experience with a new type of slide valve which is absolutely and perfectly balanced. The engine carried 200 lbs. of steam anywhere and at any time, and it is equal to the piston valve as far as balancing is concerned. It has the further advantage that the packing for balancing the apparatus is absolutely stationary. There is no movement to it whatever; and from past performances we have every reason to expect that the future will be the same. The wear will be a minimum and the only wearing surfaces are the valve seat and the upper plate, which is identical with the valve seat. With this type of valve, owing to its perfect balancing, you can do everything that you can with a piston valve, external or internal admission, and you further have a double port arrangement, not like the Allen but simpler and more effective; and while there has been no absolute test made on it yet the opinion of the road foreman is favorable to it and the engineers have been greatly pleased with this valve.

Mr. J. A. Carney (C. B. & Q.)—We find that the advantages which the piston valve presents are longer ports than it is possible to get with the slide valve. This gives us a very good steam admission and a very nearly absolutely balanced valve. One of the disadvantages of the piston valve is the rapid wear from the rings, and we have found from experiments that the steam ring does not give much bother from wear except at the point where the two ends of the ring unite; but that the exhaust ring, after a certain amount of wear, will close down over the action of the exhaust and blow around the ring, so that a piston valve which has been in service for some length of time will show a very fair steam admission, cut-off, but the exhaust is in very poor shape and the result is a weakened engine.

The subject was referred for topical discussion at the next convention.

Does the extension of the smoke-stack into the smoke-box materially assist in the steaming qualities of an engine and minimize the danger of such an engine throwing sparks?

Prof. W. F. M. Goss—Referring first to outside stacks, I would say that it seems settled that the higher the stack we use, the more efficient the front end arrangement, other things being equal. The 60-in. stack is better than the 24-in. stack. As we go out from the outside stack, we lose slightly in efficiency with each reduction in length. Now the inside stack if used enables us to maintain the advantage of the long stack and at the same time have an amount projecting above the top of the smoke-box not too great for clearance space. Therein, as I understand it, lies the advantage of the inside stack. It is evident, of course, that as the stack is extended downward into the smoke-box the nozzle also should be lowered in order that a proper spacing between the nozzle and bottom of stack may be maintained. It is interesting to note, however, that with the inside stack the desirable distance between the nozzle and the bottom of the stack may be very much less than is usually assumed to be necessary between the nozzle and the outside base of the stack. Experiments which we have made show that the distance between the lower edge of the bell of the inside stack and the top of the nozzle may be as small as 10 in., and yet maximum results be obtained. This, you see, admits of having a very considerable extension of stack down into the smoke-box, without the necessity of very much lowering the nozzle. I believe it is possible by means of such an arrangement to secure the full advantages of the long stack which in small engines we now enjoy by having the long outside stacks. I should add that the inside stack, which was the subject of experiment, had a bell at the bottom, increasing in diameter from 14 in., the diameter of the stack, to 24 in., the diameter of the bell.

In addition to the advantage of giving the effect of the long stack, it seems to me that the adoption of the inside stack will sooner or later lead to the simplification of the inside arrangement of the front end. I believe that by locating the center of activity within the smoke-box at a point lower down in the front end, that perhaps the effect of the diaphragm may be diminished, and we shall find a way to greatly enlarge the opening under the diaphragm or perhaps get along without it altogether. Thus there may be a two-fold advantage in using the inside stack, first, by its use we maintain the desired degree of efficiency through having a proper length of stack; second, we change the center of activity within the smoke-box to such an extent that it may be possible to eliminate the diaphragm. The subject which was assigned to me also includes the question of spark losses and upon that phase of the question I cannot speak, since I have done no work upon it.

Mr. John Player—I notice that Prof. Goss has recommended the extension of the stack downwards inside the smoke-box, or, as he terms it, an inside stack, to provide a sufficient amount of draught. We went into that some years ago when we first commenced building the large engines with short stacks, and although theoretically you obtain a better draught than you do with the outside stack, yet we found in actual practice that with an engine, provided with the inside stack, it is a very long time from the period of shutting off steam until a sufficient amount of draught is obtained through the inside stack to clear the smoke-box and consequently the fire-box. When we got into the use of wide fire-boxes, burning bituminous coal, the objection became far more apparent and we had to abandon the inside stack as a continuous stack and cut it off at the base, using a lift pipe, practically the same size as the inside stack would be, and leaving an opening about 2 in. in depth of the circumference around the base of the stack so as to permit the front end to clear itself.

Mr. Symington—I would like to say that the point raised by Mr. Player is one which every one will discover, when you extend the stack down in the smoke-box, that the engines will "kick back." I overcame this trouble entirely on some engines by cutting off the upper part of the smoke-box, by putting a blank plate over the flue sheet forward about the level, or just above the level of the bottom of the stack extension. This is a very simple thing to do, and a reduction of volume in the smoke-box does not affect the steaming of the engine at all, and I think if it is tried on either the narrow or wide fire-box engines, that Mr. Player will find that trouble will cease.

FLEXIBLE STAYBOLTS.

The last topical discussion of the Master Mechanics' convention, "Has the use of flexible staybolts in side sheets of locomotive fire-boxes overcome the difficulty of broken bolts, and have the benefits derived from same been enough to overbalance the extra cost of flexible staybolts," was opened by Mr. T. A. Lawes.

Mr. Lawes—The cost of renewing 105 staybolts, in lots of six at a time, in one year on a certain engine, carrying 200 lbs. of steam, was $113.40. This includes taking down and putting up the parts of engine in the way of boilermakers; it also includes cost of blowing off engine, letting water out of boiler and filling same and cost of water. The cost of the same number of flexible staybolts, put in at one time, when engine was in back shop for repairs, was $94.50; no charge for stripping, as flexible staybolts were applied when new sheets were put in. From this it appears that the cost of flexible staybolts for the first year's service is $18.90 less than the same number of common staybolts. Now, if the same number of common staybolts break in the second year, we would save $113.40. However, since the side sheets of our engines carrying 200 lbs. of steam, last but two years, flexible staybolts are renewed with side sheets, except that the brass sleeves and caps are used again with the new staybolts. So far as first cost is concerned, flexible staybolts are cheaper than common staybolts, when common staybolts are renewed in roundhouse in lots of six at a time.

The great advantage in the use of flexible staybolts is that the service of the engine is increased, since they do not break and engines are not held for renewals of bolts.

It is our rule to take out staybolts where six adjacent staybolts are broken. The loss of service of our engines under this rule, in one year, taking out 105 staybolts and renewing them, amounts to 12 days. In addition to labor and material this period also includes the time it takes to blow off steam, letting out water and cooling off boiler, so it can be worked in; also filling up the boiler, but not getting up steam.

It may be of interest to state that the greatest number of flexible staybolts we have used in one engine is 430; the least is 140. We have 27 engines equipped with these bolts—in all 5,280 flexible staybolts in use.

We use the flexible staybolts invented by Wehrenfennig, Chief Engineer of Material of the North Eastern Railway of Austria, improved by W. Leach, Foreman Boiler Maker of one of the railroads of India, and still further improved by the Pennsylvania Company; no doubt you are all familiar with this flexible staybolt, as it is used in great numbers by that company. The patents on this type of flexible staybolts have long since run out and they can be used by anyone without royalty.

Mr. West—We have a large number of wide fire-box engines known as the Wooten type, though they do not have the Wooten patent, in other words, our flue sheets are straight. Eighty-five wide fire-box engines had 3,202 broken staybolts from Jan. 1, 1901, to Dec. 1, 1901, a period of 11 months. The average number per engine was 38; average per month per engine, 3. 29.65 per cent. of the total 3,202 were from boilers that were from eight to 11 years in the service, and represented 56 of the 85 engines. The other 29 engines have been in service from one to six years, and only had 237 bolts broken. I think there was as much in the design of the boiler Mr. Lawes refers to as in the staybolts or water; that the trouble was as much with the boiler as anything else. I would state that we have several of these engines in service and have had them for three years, and never had a staybolt broken. We never allow a single staybolt to remain in service after it is demonstrated that it is cracked or broken.

Mr. F. F. Gaines—My experience has been as Mr. West states, the form of the fire-box undoubtedly has something to do with the breaking of the staybolts.

Mr. West—Our experience has been that the staybolts in the wide fire-boxes crack, and we keep a correct record and have a print showing the location of every bolt removed in 12 years, and it is demonstrated that they start to crack very close to the mud ring and each year or two creep up to the point where the staybolts were longer. I do not think we had a single staybolt broken, which was 8 or 10 in. long, until the engines had been in service five or 10 years. I do not think we had a broken staybolt which was 9 in. long.

Mr. Mitchell (N. Y., O. & W.)—The first bolts we had broken were in the throat sheet, and then they went back to the front corner of the fire-box and gradually worked toward the center and worked up. We have many fire-boxes which have been in use for 11 years and we never had a broken staybolt more than 9 in. long.

Mr. John Player—I would fully corroborate Mr. West in his statement that the type or design of the boiler has a great deal to do with the breaking of staybolts. In our varied experience with different types of boilers and different designs of boilers, we frequently received reports of excessive breakages of staybolts in certain designs, and on comparing the different types of boilers on which the breakage of staybolts took place, this practical information is quite interesting. I think some action should be taken by the Association to improve the design of the fire-box by increasing the water space and eliminating some of the existing curves in the narrow fire-box engines, and in designing wide fire-box engines with special reference to obtaining less breakage of staybolts by increasing the water space upon the sides, and spacing the staybolts in such manner as to eliminate the breakage. I have in mind one particular design of boiler that we built several years ago which I felt sure would give us very great breakage of staybolts and my suspicions at the time were verified by the fact that at the present time they have a type of boiler on the road for which those engines were furnished, which are provided exclusively with flexible staybolts. We cannot keep the ordinary staybolts in place.

Mr. S. W. Miller (Pennsylvania)—We have used a great many flexible staybolts. They do sometimes break, but we find that the breakage is generally due to one of two causes. In the first place, the socket or ball joint seat becomes filled with lime in bad water districts, and makes practically a solid staybolt. In addition to that, the boiler makers, if not watched carefully, will get the sleeves screwed into the boiler, so that the expansion of the sheet will make the staybolt bear against the inside edge of this socket, making the staybolt really shorter than it would be if an ordinary staybolt were used. We find we have to watch that pretty closely.

The flexible staybolts cost less to maintain than the staybolts in ordinarily constructed fire-boxes, where the water space is not very wide. I saw not long ago a boiler that was just having a fire-box put in where the space at the mud ring was 3 in. on the side sheets, and the space at the top of the flue sheet was less than 2 in.

A number of years ago we made a very general investigation of the breakages of staybolts; all classes of engines were taken and every staybolt that was broken was reported. We found that the place where the staybolts broke varied in each type of engine, but was very generally the same for the engines of each type. As a general proposition, the staybolts in the upper front corner of the fire-box broke the most so that we found it was advisable to make an application of the bolts in a triangular shape about five back and forward on the top row, four or five in the front vertical row and tapering off from one corner to the other, so that there would be probably 12 to 14 flexible staybolts in the corners. In addition to that we now drill every staybolt in the fire-box as new side sheets to the fire-box are applied, drilling the bolt before they are put into the boiler, as we find the drilling after the staybolts are put in is not reliable. In one case where we tested the boiler five times after the staybolts were drilled from the outside and staybolts drilled in the fire-box, each time we found more broken or cracked staybolts. The hole was drilled partly through into the water space.

Mr. Lawes—While we can build boilers in which the fire-box is properly designed to prevent broken staybolts, the matter which concerns us most at the present time is to prevent the breaking of staybolts in the boilers already built. A portion of this discussion had reference to the Wooten type of fire-box burning anthracite coal, but the great majority of engines in use are those which burn bituminous coal, with the fire-box on top of the frame and of the narrow type, so do not be deceived by thinking we can build boilers and get rid of this trouble with staybolts. We must consider what we have to use at the present time. As to the matter of six staybolts to be renewed at a time, we drill all our staybolts, and when the leakage appears at the hollow in the staybolt we have some of the staybolt left and we do not consider it dangerous. We have never had any trouble. It is a different proposition when they are broken off entirely, six at a time.

Mr. Miller—It is important to watch the staybolts which are drilled. I have known of a number of cases where the trouble with the staybolt is in the cab, and the steam caused the engineer some inconvenience, and it was a simple matter for the engineer to drive a wire nail in these leaks to conceal any evidence of the leak.

OFFICERS.

The following officers were then elected for the ensuing year: President, George W. West, New York, Ontario & Western; First Vice-President, W. H. Lewis, Norfolk & Western; Second Vice-President, P. H. Peck, Chicago & Western Indiana; Third Vice-President, H. F. Ball, Lake Shore & Michigan Southern; Treasurer, Angus Sinclair; Secretary, J. W. Taylor. The convention then adjourned.

RAILROAD GAZETTE

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The House accepted the Senate bill, namely, the Spooner bill, authorizing the President to proceed with the construction of the Isthmian canal, on either route as he may decide and it has been signed by the President. The essentials of this bill appeared in the *Railroad Gazette* of June 27, page 499. The reader may have noticed that the work is to be carried out by a commission of seven (to be appointed by the President and confirmed by the Senate), at least one of whom must be an officer of the Army and at least one an officer of the Navy; and these two officers are included in a group of at least four engineers. It follows, that there may be two engineers appointed from civil life, and, indeed, that there may be more. It is fair to suppose, however, that the authors of the bill had in mind the idea of having three members of the commission representing professions and affairs other than engineering. At any rate, those who took alarm last winter at the prospect that engineers from civil life would have no hand in this commission will see that their fears were a little premature, as we suggested at the time, for we had no notion that the Hepburn bill would ever become a law.

Concerning Electric Tunnels.

At the time of the collision in the tunnel of the New York Central Railroad in New York City, it was pretty generally assumed that if the tunnel had been worked by electricity, instead of steam locomotives, there would have been no accident. At the time, we took pains to point out that the accident would probably have happened. It was a clear case of the engineman over-running signals, and the probability is that he would have done the same thing had he been running an electric train. To be sure, the signals would have been more easily seen had there been no smoke in the tunnel, and his confused intelligence might have been arrested by them, but there was a whole set of facts which indicated that he would have run past any signal.

We pointed out further, that the accident would probably have been much more terrible had the tunnel been worked by electricity, for the reason that the wreck would probably have been set on fire. Confirmation of this opinion came speedily in two electric tunnel fires in England. Simultaneously with our writing, Mr. George Westinghouse made some public expressions of opinion along the same line, which aroused discussion, not to say indignation. His purpose, and ours, was not to oppose the use of electricity as a motive power, for no man in his senses would do that; but to help the use of electricity as a motive power by urging the use of such design and construction as would reduce to a minimum the danger of fires.

In the last three months we have collected a few press clippings from New York papers giving information of electric car fires, not making any effort to get further information. It is certain that we have not seen reports of more than a small percentage of the fires of this sort that have taken place, but we have gathered enough to fully justify all that Mr. Westinghouse said, and what we said.

For instance, on June 30 three electric cars of the Elevated railroad in New York City were burned to the trucks. They were standing on a siding and no passengers were in them. The newspaper reports say that "there were flashes of dazzling brilliancy and sundry reports like the explosion of cannon crackers." One reporter says: "The fuses and the cylinders of the air brakes blew out;" what that means we cannot guess. On June 28 a surface car on Sixth Avenue, in New York City, took fire from an electric wire. It was an open car and the passengers got out without damage. Firemen quickly put out the blaze. On the 26th a fuse blew out on the Third Avenue Elevated. This was followed by a panic in which a number of people were injured, none dangerously, we believe. The car was slightly burned. On the 23rd a fuse blew out on a trolley car on Long Island. The motorman is said to have stopped the car, and then jumped off with his clothes on fire. Several passengers were burned, some of them severely. June 18 a car on Eighth avenue, New York, was set on fire by the burning out of a fuse. The fire was put out by firemen, but the car was considerably damaged. On the 14th a car, apparently on the Broadway surface line, was set on fire. It was not far from the car barn, to which it was pushed, and the fire put out with comparatively little damage to the car. On the 6th a fuse blew out on a car of the Third Avenue Elevated, causing alarm, and slight injuries to persons. On May 30 a car on the Northwestern Elevated in Chicago was set on fire by "defective electric wiring." On May 10 a slight fire occurred on a car on the Brooklyn Bridge, and on May 2 there was a fire on a car on the Broadway line in New York. It is said that this car was almost destroyed. On April 23 a fire occurred on the Third Avenue Elevated because a workman dropped a wrench across the third rail and one of the track rails. Some of the ties were set on fire, but nothing worse happened than a short block of traffic. Of course, this is a very incomplete record, but it is sufficient to indicate the danger. It will be observed that had these accidents happened in tunnels, inaccessible to city firemen, the results would have been pretty bad.

The Manhattan Terminal of the Brooklyn Bridge.

On Tuesday of this week Mr. William Barclay Parsons, Chief Engineer of the Rapid Transit Commission, laid before that Commission a plan for the improvement of the Manhattan terminal of the Brooklyn Bridge. This plan is based on the fundamental principle laid down by the Board of Experts who reported on this project last autumn, which principle, as we look at it, must underlie any real improvement to the bridge, namely, the principle of sweeping away the bridge terminal entirely and treating the bridge as a part of a street. The Board, however, saw no way of taking the trolley terminal off the bridge; but Mr. Parsons goes further, and not only removes the terminal for the bridge cars proper, as did the Board, but also for the trolley cars. That is, he provides for continuing the bridge car lines northward and the trolley car line southward, thus collecting and distributing the traffic out on the streets of Manhattan Island, close to the points at which this traffic originates and to which it is destined.

Furthermore, Mr. Parsons's plan includes one of the important and scientific provisions of the plan of the Board of Experts, which was rejected by Mr. Martin, the Chief Engineer of the bridge, namely, that provisions which collects and distributes traffic south of the bridge as well as north. In fact, a very important part of the bridge traffic originates south of the latitude of the bridge, and the Board of Expert Engineers provided for intercepting this traffic before it could get to the bridge. This provision Mr. Parsons accepts.

Still further, Mr. Parsons accepts the important project of connecting the New York ends of the bridges and providing for the circulation of trains, providing also (and this is very important) for carrying the traffic which crosses the Williamsburg bridge, or Bridge No. 2, down to a point near the City Hall.

He accepts also the important provision contained in the plan of the Board of Experts, which keeps the line connecting the bridges along Centre street, thus laying that line of travel as close as possible to Broadway. The importance of this seems to be sufficiently obvious to anybody who reflects upon it.

Mr. Parsons's plan, therefore, contains all of the essentials of the plan of the Board of Experts and goes further in an important essential, namely, that which takes the trolley car terminal off the bridge. It does all this, however, at a very serious cost, namely, a larger cost of construction, a longer time of construction, a more serious and longer continued interference with the traffic of the bridge during the period of construction. These were three points which entered seriously into the deliberations of the Board of Experts, who tried to keep the cost down to such a point that the city debt limit would not stand in the way of the project, to keep the time of construction down to the lowest possible limit, and to begin to produce relief even before the construction was completed, and, finally, to permit practically no interference with the use of the bridge.

Mr. Parsons's plan is much more radical. He proposes to take all of the cars crossing the bridge, both the bridge cars proper and the trolley cars, into subways on Manhattan Island, taking the bridge cars northward under Centre street and the trolley cars southward down Nassau street. The bridge cars would loop around to the ends of the new bridges. The trolley cars would loop around and recross the river by a tunnel somewhere about the latitude of Maiden Lane, coming to the surface in Brooklyn somewhere in the neighborhood of the City Hall.

In order to do this, he would begin at the anchorage of the bridge and cut down in the masonry, dropping the tracks on a grade of 4½ per cent., thus emerging on Park Row at the grade of the Rapid Transit underground railroad now building. This involves lowering the grade of one street and vacating another one; obvious expedients which the Board of Experts considered, but which they rejected because of the great difficulty in getting rights to carry out such a project. However, if the matter is brought forward with the backing of the Rapid Transit Commissioners it is not at all impossible that this may be done.

Mr. Parsons estimates the cost of the underground construction across Park Row and up Centre street at about the same as the cost of building the elevated railroad, as estimated by the Board of Experts and Mr. Martin, including, of course, damaging to abutting property. He does not, however, put in any estimate of the cost of acquiring and vacating property, or of changing the structure of the bridge itself.

Mr. Parsons's plan presents one great advantage, namely, that it would sweep away the buildings at the New York end of the bridge and leave an unbroken view of the bridge from City Hall Park. It would be a beautiful and dignified addition to the architecture of the great city.

The newspapers have jumped to the conclusion that it would do away with the foot bridge across Park Row, but reflection will show that the enormous traffic to and from the Manhattan Elevated Railroad station must be carried above the grade of the street somehow. The bridge, however, need not occupy the position in which it now stands, but could be moved further north and so no longer interfere with the unbroken view of the Brooklyn Bridge itself.

Another great advantage claimed for this plan is that it avoids building any more elevated railroads on Manhattan Island, and it is held that if the proposed elevated railroad up Centre street were built, the next step would be one or two elevated roads across the city from east to west. In the present state of public opinion this is a powerful argument. The press of New York is almost a unit in opposing the building of any more elevated railroads. So far as we can judge the Rapid Transit Commissioners are unanimous against any more elevated railroads. Probably the weight of opinion all through the city government is in the same direction. We think that this is a great mistake, that it is unfortunate, that it will cost the city a great deal of money. We have little doubt that within a very few years there will be a reaction, and that more elevated railroads will be built; but, at present, it seems idle to contend against this overwhelming sentiment. Of course, the Rapid Transit Commissioners have it in their power to change this sentiment, and to change it very promptly; but they themselves would first have to be converted. All of this being so, Mr. Parsons, with the plan that he now brings forward, stands in a position of great strategic strength.

The most serious objection to his plan is the long time that must elapse before any relief is felt. Under the plan of the Board (accepted and a little modified by Mr. Martin) relief would have begun in a few months; under this plan it is a matter of a few years. An operating objection is the heavy grade. All the motor car equipment must be governed by this one short grade, and the cost of working that grade will be a tax on traffic as long as the bridge stands.

Iron and Steel in 1901.

Some 10 days ago Mr. James M. Swank submitted to the American Iron & Steel Association his Annual Statistical Report for 1901. It is the familiar yellow-covered pamphlet to which those of our readers who are interested in such matters are accustomed. The tables relating to pig iron production have been greatly extended. The department devoted to prices has been enlarged to embrace monthly prices of steel bars at Pittsburgh in the last six years, monthly prices of tin-plates in the last six years, and average yearly prices of Connellsville coke. A careful examination of the iron and steel industries of Canada is included, and the statistical tables dealing with the British and German trades are the most comprehensive ever published by the Association. The document may be had of Mr. Swank, at 261 South Fourth street, Philadelphia.

A few of the most important items in the general statistics are presented in the table below, all being gross tons:

	1900.	1901.
Total production of iron ore......	27,553,161	28,887,479
Pig iron, including spiegel and ferro	13,789,242	15,878,354
Bessemer steel ingots and castings	6,684,770	8,713,302
Open-hearth steel ingots and castings	3,398,135	4,656,309
All kinds of steel...............	10,188,329	13,473,595
Structural shapes, not including plates	815,161	1,013,150
Plates and sheets, except nail plate	1,794,528	2,254,425
Rolled iron and steel, except rails.	7,101,761	9,474,688
Bessemer steel rails.............	2,383,654	2,870,816
All kinds of rails..............	2,385,682	2,874,639
All rolled iron and steel, including rails	9,487,443	12,349,327
Imports of iron ore.............	897,831	966,950
Exports of iron and steel, value...	$129,633,480	$102,534,575

It will be observed that there was a small increase in the imports of iron ore. The amount imported from Cuba in 1901 was 523,000 tons, as against 369,000 in 1899. An indication of the course of prices for two years is given in the small table below:

	1900	1901
No. 1 foundry pig iron at Philadelphia.....	$19.98	$15.87
Gray forge pig iron at Pittsburgh.........	16.90	14.20
Bessemer pig iron at Pittsburgh...........	19.49	15.93
Steel billets, at mills, at Pittsburgh.......	25.06	24.13

The furnaces in blast at the close of the year numbered 266, as against 232 at the close of 1900. Those using bituminous coal and coke were 188, anthracite 54, and charcoal 24. The furnaces out of blast at the close of 1901 numbered 140, or 34 less than at the close of 1900. An interesting study is the consumption of pig iron per capita of our population. In 1901 this amounted to 464.4 lbs. In 1900 it was 386.8 lbs.; in 1890, 318.1 lbs., and in 1870, 105.6. The increase in 30 years may well be called amazing.

The production of open-hearth steel has more than doubled in the last four years; having increased from 2,230,000 gross tons in 1898 to 4,656,000 in 1901. Of this quantity acid open-hearth was 1,037,000. In 1900 our open-hearth steel production passed that of Great Britain for the first time, and in 1901 it was greater by more than 350,000 tons. In 1891 the total production of open-hearth steel castings amounted to 301,622 gross tons, of which 206,681 tons was acid steel. Besides this there was about 16,000 tons of Bessemer, crucible and miscellaneous castings. Of the rail production 77 per cent. was over 45 lbs. per yard, and less than 85 lbs.; and 17 per cent. was 85 lbs. and over. In 1900 these percentages had been 71 and 26 respectively; which may mean much or may not, but it is an interesting fact.

May Accidents.

We publish in another column of this issue a condensed record of the principal train accidents which occurred in the United States in the month of May. The record contains accounts of 27 collisions, 30 derailments, and 2 other accidents. Those which were most serious, or are of special interest by reason of their causes or attending circumstances occurred as follows:

2d. Clyde, N. Y.	†7th. North Topeka, Kan.
†4th. Rockwood, Pa.	*12th. Sheridan, Pa.
*6th. Flagstaff, Ariz.	†17th. Hyannis, Neb.
6th. Arkansas Junc., Colo.	29th. Alma, Wis.

The accidents fatal to passengers were those at Hyannis, Rockwood and North Topeka. In the last case the passengers were in a freight train caboose. The most disastrous train accident in the present record was that at Sheridan, Pa., causing the death of 25 or more persons; but as a train accident this collision was insignificant. No less than five accidents in the present record were due to trains or cars escaping control and running long distances unattended on descending grades.

Three train accidents figured in the newspapers for May which do not appear in the present record, for the reason that they did not occur on standard railroads open for business. At Ardmore, Ind. T., a work train broke through a trestle bridge, on a road which was barely completed and had not been put into regular operation, and 11 employees were either killed or fatally injured. An outsider, apparently a passenger riding on the train, was also killed, and 10 other employees were injured. Near Davis, W. Va., on a logging road, a train broke through a bridge and the engineman was killed. In a similar accident in the State of Washington, two men were killed; and the accident was followed by the wreck of a second train, which went down at the same bridge.

Near Norton, N. B., on May 28, a mixed train broke through a trestle bridge and the fireman was killed. The engineman went down into the water with the engine, but swam ashore.

The number of electric-car accidents reported in the United States in May was nine, in which two persons were killed, and 50 or more were injured.

In connection with the disastrous explosion at Sheridan on the 12th, the rule which should govern in the handling of such dangerous cars is a matter of interest, and we quote here the rule concerning explosions which is prescribed by one prominent railroad. The rule deals mainly with powder, dynamite, etc., "inflammable material" being mentioned only once; but it is obvious that the precautions laid down would sometimes be as valuable with cars of oil as with nitro-glycerine. The difficulty, of course, is in enforcing the rule. Familiarity with danger breeds contempt for safeguards, and this difficulty is worse with oil than with powder, because oil cars are so much more common; but enormous losses from oil explosions are also becoming common.

Rules for Freight Train Men Handling Explosives.

Cars to be placed on sidings at stations where powder or other high explosives are loaded, should always remain attached to the engine and under direct control of the engineman until finally placed in position. Other cars must not be allowed to strike a car containing explosives, and such a car must be placed in a yard or at a station where it will be subject to as little handling as possible. Under no circumstances should a car be cut off and run in under control of hand brakes, except that where cars are placed on or taken out of a spur siding and it is impossible to keep the engine attached, a rope or pole must be used to move the cars sufficiently ahead to permit the engine coupling on and placing the cars in permanent position. Cars containing explosives should be handled near the middle of the train, and should not be placed within five cars of either the engine or the cabin, if the length of the train will permit, and must not be placed next to a car loaded with oil or other inflammable material. Trainmen having cars containing explosives or inflammable material must, at every point where the train stops, make special examination of cars for hot boxes. The cards, "Explosives—Handle Carefully," must be tacked on each end of every car containing explosives, in addition to the two cards on sides of cars, and Conductors will refuse to move any car containing explosives not so carded. If necessary to set off a car containing explosives short of destination, the Conductor must advise the Agent at station where car is set off, and also the Superintendent from first telegraph office. The Agent where car is set off must use every precaution to prevent accident to the car. In case of a wreck involving a car containing explosives the most important precaution is to prevent fire. Before beginning to clear a wreck in which a car containing explosives is involved, all unbroken packages should, if possible, be moved to a place of safety, and as much of the broken packages as possible gathered up and likewise removed. With all explosives, mixing them with damp dirt renders then safer either from fire or concussion. Trainmen will understand that these rules are intended for their individual safety as well as for the safety of others.

The Pennsylvania Railroad and the Postal Telegraph.

The Postal Telegraph Company is to occupy the lines and offices of the Pennsylvania Railroad, throughout substantially the whole of the Pennsylvania lines east of Pittsburgh and Erie, except those formerly owned by the Western New York & Pennsylvania. This much appears to be certain, though the particulars of the contract are still withheld. The Western Union's 25-year contract with the Pennsylvania expired some time ago, so that the new arrangement can go into effect at any time (as soon as the physical changes can be made) though the Western Union has until December 1 to remove its property. The new contract is for 15 years, and it covers, roughly, 4,700 miles of road. The number of commercial offices in railroad stations on these lines is perhaps a thousand. It is understood that a yearly rental of $70,000 will be paid by the Postal Company on a basis of 12,000 miles of wire, and yearly pole rental of $6 per mile on each additional mile, besides which the railroad receives 50 per cent. of the cash receipts from all commercial business, and is entitled to free telegraph service to the extent of $100,000 a year, all service beyond that sum to be paid for at the rate of half a cent a word. The railroad is to furnish poles, and the telegraph company the wires. The railroad is to keep the lines in repair, which means that all linemen are to be provided by the road.

This is a somewhat remarkable overturn, for the Western Union has been in practical partnership with the Pennsylvania—as it has, indeed, with nearly all other prominent railroads of the country—from time immemorial. For a railroad man to have anything to do with an "opposition" telegraph has been as discreditable as it would be to pay his fare on a foreign road, or to marry a heathen wife. But there appears to have been an irreconcilable difference between the P. R. R. and the W. U. in regard to the terms, and the life-long partners are now to be separated. The Postal Company is reputed to be a very enterprising concern, while the Western Union has lately been charged with being decidedly unenterprising; and the Pennsylvania people seem to have concluded that a change might be beneficial "on general principles." They deny the truth of the reports that they are unfriendly to the Western Union because it is managed by the Goulds, who threaten to compete with the Pennsylvania by establishing a new railroad from Pittsburgh to Baltimore.

The Pennsylvania Railroad has an extensive telegraph establishment of its own, so that the present arrangement does not mean that the Postal Company is going into the railroad business. At all of the terminals and at many other stations the railroad company has a large telegraph office, and, of course, its own wires and poles. The magnitude of this business may be inferred from the fact that the road makes its own telegraph instruments at Altoona. As the Pennsylvania, east of Pittsburgh, is perhaps the busiest railroad in the country, the fact that its railroad telegraph department is a large one is a natural sequence; but we are probably safe in saying that the telegraph department is even larger, in proportion to the amount of passenger and freight traffic carried, than on any other road. In addition to the telegraph, the road has the exclusive use of one or more long distance telephone circuits between all of the large cities on its lines. The use of Delany's rapid telegraph between Philadelphia and Pittsburgh for railroad messages, as recently announced in these columns, will be fresh in the reader's memory.

The Postal Company was, of course, already connected with all of the large towns in Pennsylvania, so that no radical change is made in its facilities for through business. The advantage to it is in the access to a large number of small places, and in the improved facilities due to getting lines on the railroad right-of-way. The Postal is not entirely new to the railroad field; it has done business on the line of the Chicago Great Western (1,271 miles) for several years. It also operates on the Grand Rapids & Indiana, the New York, Philadelphia & Norfolk, and the San Francisco & San Joaquin Valley. It also operates on the Ann Arbor road and on important lines of the Illinois Central south of the Ohio River.

All's well that ends well; the Chicago & North Western has signed the per diem agreement and the New York, New Haven & Hartford has adopted the plan—whether it has signed or not; so that with the end of the period of discussion we may say that the railroads of the country are unanimous in their disposition to earnestly endeavor to carry out this important reform in car-service. The arrangements which it was found necessary to make at the large cities for dealing with switched cars appear to have been made with but little friction. Some of these agreements have been made for a term of three months. If they are irrevocable for that length of time the idea is a good one. The Wood River Branch Railroad, in Rhode Island, has notified its customers that hereafter demurrage will be charged on freight cars at the rate of a dollar a day. The reader may, perhaps, wonder why we mention the Wood River Branch; it is only six miles long, and the total number of its cars and locomotives together is only five. But we mention it because it is a straw which shows the way that the wind is blowing. There are many such straws in the air. At Des Moines, Iowa, demurrage rules have been agreed upon, for the first time. It appears that during all these dozen years past, when other cities were enjoying the benefits of demurrage reforms, the roads centering in Des Moines have been unable to reach an agreement; but now that the screws are tightened, definite action results. At Buffalo a circular announcing the enforcement of demurrage was issued by the Pennsylvania a month ago. At Chicago an agreement has been reached to consider five days a reasonable length of time for which a switching road may reclaim per diem from the road for which the switching is done. We have said that the railroads are practically unanimous. There is, however, one important party, not a railroad, which at last accounts was still obdurate; the United States Steel Corporation. This concern, with its immense mills, at many different places, is of the nature of a gigantic "private siding," carrying railroads of considerable length in its pocket, as it were. Its use of cars owned by the railroad companies will, no doubt, involve some complicated problems. But the underlying principle at stake is the same that has to be dealt with elsewhere, and it cannot be that any insuperable difficulty exists. If anybody thinks that the mere bigness of the steel corporation is a difficulty, let him remember that a billion-dollar mill corporation is only a baby when compared with a twelve-billion-dollar railroad combine.

It is announced that the Pennsylvania Railroad will pay rebates to passengers on its 20-hour Chicago trains whenever these trains are more than two hours late. If the detention is two hours, and not more than three hours, the rebate will be $2. For the next hour it is $3, and for four hours or more it is $4. It is understood that proportionate rebates will be paid to passengers to and from Pittsburgh, Altoona, Harrisburg, Philadelphia. The report that rebates would be paid in case of delay has been published as a rumor for several days, but now we have it from an officer of the road. This is a genuine novelty. What if it should become the fashion on ordinary trains?

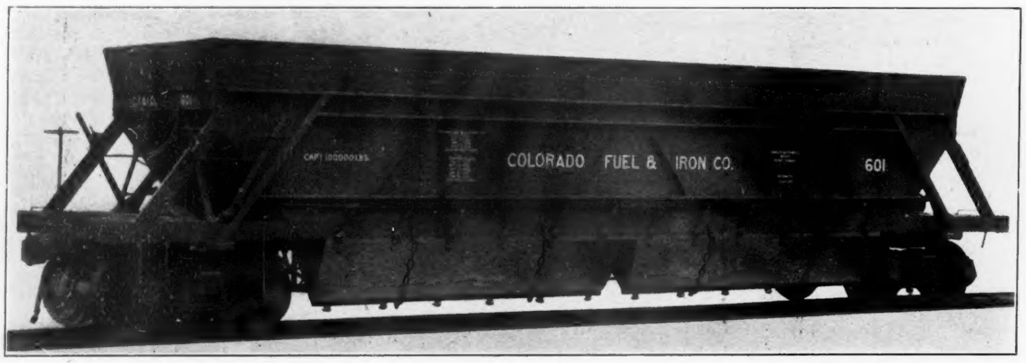
Among other interesting announcements made by President Hadley at the Alumni dinner at Yale last week, was that of the appointment of John Hays Hammond as a professor in the Sheffield Scientific School. The purpose is that Mr. Hammond shall direct the practical part of the course in mining engineering. Considering that Mr. Hammond's time is worth $100 an hour, more or less, his acceptance of this position must be a matter of pure patriotism, coming from a desire to serve the profession and to serve his Alma Mater. Indeed, he accepts no compensation from Yale. This is a great thing for Mr. Hammond to do, after having made his position and fortune. It will seem odd, however, to call him professor. Another aspect of this appointment is as an illustration of President Hadley's keen and prac-

tical sympathy with actual life. In this he is not only keeping up the traditions of Yale, but bettering them.

According to the *Railway News*, of London, the Amalgamated Society of Railway Servants, the principal railroad employees' organization in Great Britain, is not so prosperous as it was. A recent report shows a membership of less than 56,000, which is only about 10 or 11 per cent. of the total number of railroad employees in the United Kingdom. In the preceding year the number of members was about 62,000, and four years ago it was about 86,000. The financial report also shows an unfavorable tendency. Certain local branches of the society have asked the courts for an injunction to prevent the expenditure of its funds in the litigation with the Taff Vale Railroad, which sued the society for damaging the railroad company's business by a strike. One of the reasons given for the waning popularity of the society is the introduction of the piece work system by some of the roads. In a large freight house in London the railroad company has abolished the long-hours grievance by paying the men according to what they do, so that now they go home earlier and with more money in their pockets.

Test of an Ingoldsby 100,000 lbs. Capacity All-Steel Dump Car.

In our issue of April 4 of this year we gave an illustration and summary of tests of an Ingoldsby wooden dump car of 100,000 lbs. capacity. We are now permitted to give similar information concerning an all steel dump car of the same nominal capacity. The illustration shows one of a number of dump cars now being built at Detroit for the Colorado Fuel & Iron Co., and is of the Ingoldsby patent type.



Ingoldsby All Steel Dump Car.

A car of this kind was tested by Mr. F. R. Bowling, Mechanical Engineer of the Ingoldsby Co., and from his report we take the following facts:

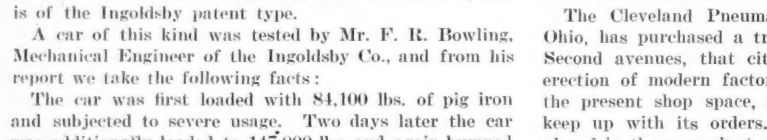
The car was first loaded with 84,100 lbs. of pig iron and subjected to severe usage. Two days later the car was additionally loaded to 147,000 lbs. and again bumped about over frogs, switches and obstacles on the track and was finally kicked into a loaded train of freight cars. No damage to the test car was noted. Three days later the total load was increased to 200,100 lbs. and subjected to similar treatment. After all parts had settled into place the maximum deflection at no place exceeded ⅜-in. One man dumped by hand power 147,000 lbs. of the load in 10 seconds.

The car was afterwards given a load of 138,600 lbs. of coal and subjected to test. The outward bulge of the sides was but $^1/_{16}$ in. on each side.

These cars have no ties across the center of the car at the top and are open from end to end as in ordinary gondolas.

A New Stadia Slide Rule.

The adoption of the stadia in surveying has been somewhat retarded by the difficulties in reducing the observations. When the reductions are made by an actual numerical application of the formulas (even with the assistance of tables) the operations are tedious. Diagrams, from which the desired values may be directly read, are either drawn on so small a scale that the required degree of accuracy is unobtainable, or they are too large for use in the field and are clumsy for office use.



The Webb stadia slide rule is so designed that its capacity and accuracy is equal to that of a straight slide rule with a length of more than 4 ft., but it has been compacted to a cylindrical form with a length of about 15 in. and a diameter of 1½ in. It is therefore of convenient size to carry and use in the field, thus facilitating the drawing of field maps. The desired quantities are given with a degree of accuracy which is commensurate with the probable accuracy of the observations as read, the logarithmic unit being 12½ in. long.

It should be noted that the true horizontal distance is obtained by computing the correction to the distance as read from the wires (rod reading). Since the correction is always small, its true value (to the smallest unit used) may be more readily determined than the exact value of the distance itself, since sin^2 of a small angle varies more rapidly than cos^2 of the same angle.

The rule is the result of a long experience in the practical requirements of such a device, and it is claimed that the accuracy is as close as the actual instrument work. Full directions are printed on each rule. The Keuffel & Esser Co., New York, sell this instrument.

TECHNICAL

Manufacturing and Business.

The Simplex Railway Appliance Co., with headquarters at Hammond, Ind., has opened a branch in Canada and a factory site has been chosen at St. Henri, near Montreal.

W. E. Taylor, formerly General Manager of the Republic Iron & Steel Co., is said to have bought a controlling interest in the Niles & Scott Wheel Co., of Laporte, Ind.

The Caswell Car & Improvement Co., Chicago, writes us that it has given up the idea of establishing a car works at Stevens Point, Wis., but instead has made a contract with a large car building concern to make its cars.

After July 1 the office of Ira C. Hubbell, the Buyer of the Kansas City, Mexico & Orient Railway, and the International Construction and Union Construction Companies, will be located at room 404, Columbia Building, St. Louis, Mo.

After July 1 the northwestern office of The Pennsylvania Steel Company will be located in the Western Union Building, Chicago, Ill., in charge of Mr. Clifford J. Ellis, Sales Agent, and Mr. Robert E. Belknap, Assistant Sales Agent.

The Cleveland Pneumatic Tool Company, Cleveland, Ohio, has purchased a tract of land on Hawthorne and Second avenues, that city, and will at once begin the erection of modern factory buildings. It has outgrown the present shop space, and the company is unable to keep up with its orders. About 150 men will be employed in the new plant. Electric power will be used in driving the machinery.

Iron and Steel.

The United States Ship Building Co. will increase its capital stock from $20,000,000 to $45,000,000, partially as the result of the acquisition of the Bethlehem Steel Co. The total capitalization will be divided into $20,000,000 preferred and $25,000,000 common stock.

John H. Kendin, of the New Process Casting & Mining Co., recently organized at Homestead, Pa., is reported as saying that the company will soon begin work on a plant in the Pittsburgh district to make steel castings by a new process, which it is calculated will reduce the cost 30 per cent. He says the proposed furnace is to be of 500 tons daily capacity and there are to be three foundries.

The Empire Contracting Co., with a capital stock of $100,000, was incorporated in New Jersey July 1 to do a general contracting business, including the construction of railroads and bridges. The incorporators of the company are Louis B. Dailey, H. O. Coughlan and K. K. McLaren, all associated with the Corporation Trust Co. of New Jersey, through which institution the papers of incorporation were filed. The temporary address of the company is given as Jersey City.

General Samuel Thomas has retired as President of the United States Cast-Iron Pipe & Foundry Company, owing to continued ill health. He has been succeeded by George B. Hayes, who has been practically the head of the company for the last year. These other officers have been elected: Vice-Presidents, George J. Long and A. F. Callahan; Secretary and Treasurer, B. F. Horton; Executive Committee, Colgate Hoyt, A. C. Overholt, E. R. Thomas and A. N. Brady. At the annual meeting of the company's stockholders on Wednesday P. J. Goodhart, David Giles and W. T. C. Carpenter were elected new members.

The Underground Railroad From New York to Brooklyn.

The Rapid Transit Commissioners of the City of New York have advertised for bids for proposals to build, equip and operate for 35 years (with the right to renew for 25 years) an underground and under-river railroad between the cities of New York and Brooklyn. This will begin at the south end of the underground road now building; namely, at City Hall, and will go south under Broadway and Bowling Green to State street, under State street and Battery Park to Whitehall street, under the East River and so under Joralemon street, Fulton street and Flatbush avenue to Atlantic avenue. There will also be a loop at the south end of Manhattan Island for trains to turn and again proceed north. The specifications are for a two-track road in shallow subway, like the underground road now building. The East River tunnel, however, is to be in tubes of steel or cast-iron and concrete. The bidders must deposit $1,000,000 in cash or securities. Further, they must give a bond for $1,000,000, or a further and continuing deposit of $1,000,000. Bidders must specify an estimate of the cost of equipment on which their bids are based, this to include all rolling stock, all power machinery and the land on which power houses are placed. Work must be begun within 60 days after the contract is executed, and finished, ready for operation, within three years.

The River and Harbor Bill.

The River and Harbor Bill appropriates $65,107,602. Of this $25,521,442 is for the next fiscal year, and the remainder is for continuing improvements after June 30, 1903. Apart from the enormous appropriations made there are some features of unusual interest in this bill, and we shall give considerable extracts from it next week.

Letter Ballot on Signal Practice.

The Committee on Signaling of the American Railway Engineering and Maintenance of Way Association, has issued a circular, in accordance with instructions given by the Association at the last annual meeting, asking members to give their preferences in the matter of the position of the arm in semaphore signals, and as to what arrangement is favored for preventing the display of an all-clear signal at night, when the arm droops. The circular is accompanied by diagrams. In the matter of positions, the member is asked to choose between the three position signal, in which all-clear is indicated by a vertical arm; and the two position signal, in which the all-clear indication is shown in the diagrams (a) 70 deg. from the horizontal, or (b) 60 deg. The arrangement of lights is shown in four different diagrams. First is the common arrangement, by which when the arm drops as much as 30 deg. from the horizontal, the lamp is uncovered and shows white. In the second figure the arm and spectacle and lamp are the same, but there is a metal shield fastened to the lower side of the spectacle, so that after the red lens is lifted, the light is concealed until the arm drops fully to the all-clear position. In the third diagram the spectacle carries a red glass for the stop indication, and another glass for the all-clear indication. The centers of these glasses are 60 degrees apart, and the space between them is filled with a metal shield to conceal the light. In the fourth diagram this space between the stop lens and the all-clear lens is filled by a third opening in the spectacle, carrying a red glass, so that if the arm is part way down, but not far enough to show the all-clear indication, the light continues to show red. This arrangement of two red lenses is intended to produce substantially the same results as one elongated lens, such as that which is used in some of the signals on the Pennsylvania Railroad.

Besides indicating preferences by making marks against these several diagrams, the member is asked to say whether or not he is in favor of three positions for the signal arm. So far as appears from the diagrams, the term "three-position," as here used, refers to the practice of the Pennsylvania Lines West of Pittsburgh, in which "stop" is indicated by horizontal, and caution by an inclination 45 deg. downward. The practice of the Erie and of the Atchison, where an arm inclined 45 deg. upward is used to indicate caution, does not appear to be recognized.

Answers to the circular are to be sent to the Secretary of the Association, 1562 Monadnock Building, Chicago.

Steel Foundries Company.

The American Steel Foundries was incorporated in New Jersey last week with a capital stock of $20,000,000 of 6 per cent. cumulative preferred and $20,000,000 of common. As previously stated in these columns, the company will acquire the plants and properties of the American Steel Castings Company of New Jersey; Reliance Steel Castings Company, Limited, of Pittsburgh, Pa.; Leighton & Howard Steel Company, of St. Louis, Mo.; Franklin Steel Casting Company, of Franklin, Pa.; The Sargent Company, of Chicago, Ill., and American Steel Foundry Company, of St. Louis, Mo. The properties will be taken over as of July 1, and it is expected the new company will take control not later than July 15. The statement is made that the owners of the constituent companies declined to take any cash in payment for their properties, but instead took stock of the company; therefore the cash requirements have been very considerably reduced, and all have been guaranteed by Messrs. C. M. Schwab, E. H. Gary and Max Pam; for that reason a syndicate has become unnecessary. There will be no underwriting privileges. It is announced that the election of officers will take place next week. The incorporators of the new company were Howard K. Wood, Kenneth K. McLaren and Donald K. Mann.

General Building and Construction Company.

Articles of incorporation were filed at Albany, June 25, for the General Building & Construction Co., with an authorized capital of $2,500,000. The directors include William T. Havemeyer, Cornelius Vanderbilt, Charles T. Garvey, Henry Seligman, S. H. Chisholm, William A. Garrigues, William J. Merritt, Alex. S. Porter, H. B. Cocheu, William B. Randall, F. H. Ecker, Louis Dohme, Col. Charles H. Ropes, Charles A. Cowen, John Larken and Henry R. Hoyt.

Montreal Tunnel.

Mr. C. W. Emerson, of Boston, Mass., has been retained as Chief Engineer of the Montreal Subway Co., which proposes to build a tunnel under the St. Lawrence River from the south shore at Longueuil, under St. Helen's Island and into Montreal.

The Blackwell's Island Bridge, New York City.

The Commissioner of Bridges of New York City has ordered the contractors (Ryan & Packer) to stop operations on the anchor piers and the four main piers of the Blackwell's Island bridge. He has in mind some changes in these piers. The contractors decline to stop, as they would suffer considerable money damage by suspending work now.

The Hall Signal Company.

At the annual meeting of stockholders of the Hall Signal Company, at Portland, Me., on June 25, the following were elected directors: William P. Hall, T. Gorton Coombe, Cyrus S. Sedgwick, William H. Lyon, Thomas M. Waller, Leroy W. Baldwin and Winfield S. Gilmore. William P. Hall was re-elected President, William H. Lyon Vice-President, Cyrus S. Sedgwick Treasurer and General Manager, and Robert K. Waller, Secretary.

Bridges in New York City.

The last wire of the cables of the new East River bridge was strung on Friday of last week. The Bridge Commissioner has appointed a consulting architect to the Bridge Department, namely, H. F. Hornbostel.

American Car & Foundry Co.'s Plans.

At the annual meeting of the American Car & Foundry stockholders, on June 26, the following new directors were elected: W. G. Oakman, Thomas H. West, Adolphus Busch and H. R. Duval. The retiring directors were Geo. Hargreaves, L. J. Cox, F. E. Canda and C. R. Woodin. The directors on organization re-elected retiring officers, except E. F. Carry, who was added to the Executive Committee. The regular quarterly dividends were declared—that is to say, 1¾ per cent. on the preferred and ½ per cent. on the common—payable Aug. 1. W. K. Bixby, chairman, said that if the business of the company continued on the present basis during the remainder of the year the directors would, with conservatism, place the common stock on a 3 per cent. basis in November. He said that the working capital could probably be further increased by about $3,000,000 by the close of the year, which would bring the total working capital up to $15,000,000. He added: "The policy of the company will be, however, to continue adding to the working capital out of surplus earnings. The quarterly statement, which will cover the three months ending May 31, will show net earnings to have exceeded $2,000,000." The total output of cars during the past year amounted to 64,140. Car wheels produced, 800,000; cast-iron, 62,000 tons; cast-iron water pipe, 23,000 tons; bar iron, 83,000 tons, and the lumber produced at the company's mills amounted to 13,000,000 ft. The sales of miscellaneous products during the year showed an increase of $1,000,000 over the previous year.

THE SCRAP HEAP.

Notes.

On the evening of June 30, the "Twentieth Century Limited" of the New York Central was run from Albany to Syracuse, 148 miles, in 145 minutes; which includes a stop at Utica.

At Buffalo, July 1, the Grand Jury indicted five ticket brokers for forgery. They are accused of changing Batavia tickets to read New York, a change which increased the value of the tickets ten-fold.

Mr. Frank P. Sargent has taken up his duties as Commissioner of Immigration at Washington, and his successor as Grand Master of the Brotherhood of Locomotive Firemen is Mr. John Hannahan.

Chicago papers announce that on July 1 the rate on packing house products from the Missouri river, was advanced, by all the roads, from 18½ cents to 22½ cents; so as to make it equal to the rate on live stock.

Passenger conductors and station agents on the New York, New Haven & Hartford, have been notified that during the hot weather they may wear coats and vests of light weight, dark blue worsted, the coat to have a skeleton lining. Each employee must, however, have his regular summer uniform, as usual.

On Friday, June 27, the number of freight cars moved over the Middle Division of the Pennsylvania road was 7,033, the largest number ever moved. This is four more than the record of Sept. 22, 1900. The present heavy movement is due largely to the rush of shipments of bituminous coal, and the number of tons of freight carried was no doubt much greater than on the record day of two years ago.

The passenger department of the Southern Railway announces that that road now runs its own trains through to Jacksonville, Fla., a trackage contract having been made for the use of the line of the Plant System (now the Atlantic Coast line) south of Savannah and Jesup. These trains run over the new short line, by which the distance from Savannah, and from Jesup, to Jacksonville, is reduced 20 miles.

According to a press despatch from Chicago, a merchant of that city has traveled from Paris to Chicago (4,943 miles), in seven days (apparent time). The passenger left Paris at 8:45 a.m., June 18; Cherbourg, 231 miles from Paris, at 3:30 p.m., the same day; arrived New York, by the "Kronprinz Wilhelm," 11:30 a.m., June 24; departed from New York, 1:55 p.m., over the Pennsylvania Railroad; arrived in Chicago 8:55 a.m., June 25. The difference in time between Paris and Chicago is six hours and nine minutes.

The shops of the Union Pacific at Cheyenne were completely closed on June 24, about 500 men being dismissed. A considerable number had been dismissed before that time; the purpose to discontinue shop work at Cheyenne having been formed some time ago. The boiler makers and some of the other shop men on the road struck, or threatened to strike, last week, but it is said that that has little or nothing to do with the closing of the Cheyenne shops at this time. Press despatches concerning the strike say that it affects the whole line of the road, but no statement is made as to the number of men who have actually left their work.

Another Narrow-Gage Road Goes.

The Chicago, Burlington & Quincy is said to have completed purchase of the right of way for a connecting link between Oskaloosa and Tracy, Iowa, 13 miles. By building this section the Burlington would obtain a direct route between Des Moines and Burlington, Iowa, in connection with the Burlington & Northwestern, which has been changed from narrow to standard gage. It may be observed in this connection that the change was accomplished in nine hours, both rails being moved by a squad of 450 men over a distance of 125 miles, the preliminary grading, etc., having been made ready in advance.

Fast Run from Harrisburg to Altoona.

The mail train which made the record-breaking run from Harrisburg to Altoona, over the Middle Division of the Pennsylvania Railroad, June 21, weighed, including the engine, almost 250 tons; the weight of the cars being 280,824 lbs. The weights of the different vehicles and the speeds over various parts of the line were as below:

Train No. 11, June 21, Middle Division, P. R. R.

	Lbs.
Engine 252, Class "D-16-A," weight in working order	134,500
Weight of tender loaded	82,000
Postal storage car No. 6,609, empty weight	74,250
Postal storage car No. 6,601, empty weight	74,200
Postal car No. 6,523, estimated empty weight	82,374
Estimated weight of mail in the three cars	50,000
Total estimated weight of train	497,324

Stations.	Time, a.m.	Distance.	Speed.
Harrisburg	8:32	....	....
Marysville	8:42	7.9	47.40
Aqueduct	8:54	9.9	49.50
Newport	9:03	9.9	66.
Vandyke	9:15	13.3	66.50
Mifflin	9:23	8.1	60.75
Lewistown Junc.	9:33	11.7	70.20
McVeytown	9:45	12.0	60.
Mt. Union	9:56	12.1	66.
Mill Creek	10:04	7.6	57.
Huntingdon	10:09	5.1	61.20
Spruce Creek	10:19	11.8	70.80
Tyrone	10:27	7.6	57.
Bellwood	10:34	6.6	56.57
"EF" Tower	10:38	4.0	60.
Altoona	10:42	3.8	57.

The time was one minute more than was given in the first report; and the average speed (131.4 miles) was 60.7 miles an hour. It will be observed that the dead or non-paying weight was nearly 90 per cent. of the total. Altoona is 861½ ft. higher than Harrisburgh.

Cape to Cairo Railway.

The Cape to Cairo Railway has been surveyed as far as the Zambesi, where a great steel bridge, having one span of 500 ft., will carry the line across the river at the Victoria Falls. The whole section from Bulawayo to the Zambesi—275 miles in length, or nearly 1,700 miles from Cape Town—is expected to be opened next year. Locomotives for contractors' purposes are now running on it for a short distance north of the present terminus, and a railroad exploration party has been despatched over the route beyond Victoria Falls as far as Tanganyika. For 40 miles north of Bulawayo the earthworks are more or less complete; bridging work on the Victoria Falls section is in progress, and about five miles of the line are finished. The work of connecting the Bulawayo and Salisbury sections is also progressing rapidly, and rails are already laid from Salisbury to Sebakwe, a distance of 60 miles. From the Bulawayo end of this line the rail-head has reached the Arguza, so that when this gap is filled and the line completed, trains will be able to run from Cape Town to Delagoa Bay, via Bulawayo, Salisbury, and Umtali.—*Engineering.*

Coupons When Street Cars Are Blocked.

The Chicago City Council on June 23 passed an ordinance requiring the street railroad companies in Chicago to give passengers coupons good for one fare when cars are blocked in the streets. The coupons are to be good for one fare on any line at any time, and the time limit which constitutes a block is 10 minutes. This ordinance has not yet been signed by the Mayor.

The Railroad Associations and Saratoga.

The following resolution presented to the Master Mechanics' Association last week by Mr. M. N. Forney and unanimously adopted, expresses the sentiments of the majority of those members of both associations who attended the meetings this year at Saratoga.

Resolved, That the Master Mechanics' and Master Car Builders' Associations have met in Saratoga oftener than in any other place, and it has been found that its location, climate, waters, hotels and other attractions make it in many ways a most desirable place to meet in. There is, however, one great deficiency here—there is no room in Saratoga whose size, location, arrangement and acoustic properties are suitable for holding such meetings.

Therefore, By the passage of this resolution, it is desired to call the attention of the citizens and hotel proprietors of Saratoga to the need of such a room, and to express as the sense of this association that until a suitable place of meeting is provided it will be inadvisable to come here again. The Secretary of this Association is hereby instructed to send a copy of this resolution to the proprietors of the Grand Union and United States Hotels, and, if possible, to secure its publication in one or more Saratoga papers.

A Chance to Do Good.

The Atchison, Topeka & Santa Fe has offered to contribute $20,000 in cash and a suitable site, for a building for the Railroad Young Men's Christian Association at Topeka, on the condition that the employees of the road will raise $10,000 more. Here is an opportunity for some generous men to do good. The Association, with its organization for making life decent and comfortable for railroad men, is an element of real value in the railroad service. Obviously, it is wise for the Atchison to require the men to help to put up their building. It will be much more appreciated by them, and much more used by them, if they have the sense of proprietorship which can only come from the actual effort to raise cash for it. Subscriptions may be addressed to W. G. Boom, Chairman Railroad Department Young Men's Christian Association, Topeka, Kan.

B. & O. and G. A. R.

The passenger department of the Baltimore & Ohio has issued a handsome folder for the annual encampment of the Grand Army of the Republic, which is to be held at Washington in the week beginning October 6. It is made up of 40 pages, folder size, and contains a great amount of matter, skillfully condensed, concerning the stirring events of 1861-65, which occurred on or near the lines of the B. & O. There is a map on which the battle fields are indicated by red stars, and full page maps of Gettysburg and Antietam. No less than 179 battles were fought in the region covered by this pamphlet. Many historic spots, as well as specimens of the beautiful scenery, are illustrated by half-tone engravings. Seven pages are given up to a guide to the city of Washington.

New Railroad Law in Virginia.

By the new constitution of the State of Virginia, which goes into effect July 10, there will be in the place of the single railroad commissioner, a corporation commission. This body is to be composed of three members to be named by the Governor, and confirmed by the General Assembly. The commission is given power to fix rates for railroads, express, telegraph and telephone companies. The business of these interests is placed practically under the supervision of this body. The only appeal permitted from its decisions is to the State Supreme Court, and then the latter body can only inquire into the questions which have come before the commission for adjudication. The law forbids every State, city and county official to accept free transportation, or any other form of "deadheadism," from corporations. Heretofore the members of the Legislature, judges of the courts, from the highest to the lowest, the Governors of the State and their families, and indeed every official in Virginia, looked upon free passes as their natural right and part of the perquisites of their offices. The new Constitution makes radical changes, too, in the manner of taxing railroad property. Under the present organic law all subjects must bear the same rate of taxation. This is changed, and the tax on railroad property may be double or treble than on real estate.—Richmond letter in Philadelphia *Press.*

The Carnegie Polytechnic Schools at Pittsburgh.

The Pittsburgh newspapers say that the report of the special committee on the organization of these schools will be completed some time this month.

LOCOMOTIVE BUILDING.

The Barre R. R. is having one locomotive built at the Baldwin Works.

The Pennsylvania is having 50 locomotives built at the Baldwin Works.

The Southern Lumber Co. is having two locomotives built by the H. K. Porter Co.

The Northern Lumber Co. is having one locomotive built by the H. K. Porter Co.

The Nashville, Chattanooga & St. Louis is having four locomotives built at the Rogers Works.

The Spang-Chalfant Co., of Pittsburgh, are having one locomotive built at the Pittsburgh Works.

The Atchison, Topeka & Santa Fe is reported to have ordered 20 additional locomotives from the Baldwin Works.

The Columbia River & Northern has ordered one 18 x 26 in. freight engine rebuilt at the Hicks Locomotive & Car Works.

The H. K. Porter Co., of Pittsburgh, have just built and shipped four locomotives to the Compañias de los Ferrocarriles de Bilbao a Duranga Zumarraga y San Sebastian, Bilbao, Spain. These locomotives are moguls, meter gage, with cylinders 16 x 24 in., and are duplicates of a previous shipment, the railroad company finding the American built engines superior to those which were built by English manufacturers, previously used.

The Baltimore & Ohio has let a contract to the American Locomotive Co. for 100 locomotives for February, March, April and May, 1903, delivery. Of these, 75 will be simple consolidations, class I-7; total weight, 193,500 lbs.; weight on drivers, 173,000 lbs.; cylinders, 22 x 28 in.; diameter of drivers, 56 in.; Belpaire boilers, with wide fire-box and a working steam pressure of 205 lbs.; tubes to be 371 in number of charcoal iron, with an outside diameter of 2 in. and length, 13 ft. 9½ in.; length of fire-box, 107 in., width 66 in.; tank capacity for water, 7,000 gal.; coal capacity, 27,000 lbs. Ten of the engines will be simple, Atlantic type F-2; total weight, 177,700 lbs.; weight on drivers, 110,000 lbs.; cylinders, 22 x 26 in.; diameter of drivers, 80 in. These will also have Belpaire wide fire-box boilers, with working steam pressure of 205 lbs., and 315 tubes of charcoal iron. Outside diameter of tubes, 2 in. long, 15 ft. 1 in. out to out; firebox, 9 ft. 3 in. long and 6 ft. wide. The remaining engines, 15 in number, for March, 1903, delivery, will be six-wheel switchers, class D-7; total weight, 126,000 lbs., all on the drivers; cylinders, 19 x 24 in.; diameter of drivers, 50 in.; straight top boiler, with a working steam pressure of 180 lbs., and 198 tubes of charcoal iron, with an outside diameter of 2¼ in.; length, 13 ft. 10 in., out to out; fire-box, 6 ft. 6 in. long., 3 ft. 5 in. wide; tank capacity for water, 4,000 gal.; coal capacity, 6,000 lbs. The special equipment for all three classes of engines includes Westinghouse-American air-brakes, National hollow brake-beams, cast-iron brake-shoes, Janney or Munton couplers, Schroeder headlights, Ohio and Sellers injectors, United States metallic piston rod and valve rod packing, Coale safety valves, Detroit sight feed lubricators, and Utica steam gages.

CAR BUILDING.

The Pullman Co. is building 65 coaches for general service.

The Iowa & St. Louis has ordered 200 gondolas from the American Car & Foundry Co.

The American Car & Foundry Co. has orders for 82 cars of various types, for miscellaneous parties.

The St. Louis & Gulf has ordered from F. M. Hicks 25 flat cars to be rebuilt by the Hicks Locomotive & Car Works.

The Colorado Southern has ordered from F. M. Hicks four coaches and one combination passenger and baggage car, rebuilt by the Hicks Locomotive & Car Works.

The Columbia River & Northern has ordered from F. M. Hicks one coach, one combination car, 10 box cars and 35 flat cars, rebuilt by the Hicks Locomotive & Car Works.

The St. Louis, Memphis & Southeastern is having 14 cars for passenger service, and 465 box, flat, coal and ballast cars of 80,000 lbs. capacity, built by the American Car & Foundry Co. for July delivery.

The Southern order for passenger equipment reported in our issue of June 27, has been placed with the American Car & Foundry Co., and calls for 10 wide vestibule coaches, 25 open platform, 25 express and six combination cars.

The Vandalia is having 170 freights built at the Terre Haute Works of the American Car & Foundry Co. One hundred and twenty-five of these are to be used on the Terre Haute & Indianapolis and 45 on the Terre Haute & Logansport.

The Cincinnati, Hamilton & Dayton order for 200 coal cars, reported in our issue of June 13, calls for the same specifications as the order for 300, reported last May. These cars are of 70,000 lbs. capacity, and are 36 ft. long over end sills.

BRIDGE BUILDING.

ALABAMA.—The U. S. Senate on June 24 passed the bill authorizing the Pensacola, Alabama & Tennessee Ry. to build a bridge across the Alabama River, in Wilcox Co., Ala. (June 20, p. 484.)

BEAVERTON, ONT.—The County Commissioners have reported to the County Council that a new steel bridge be built over the Beaver River at this place.

BENICIA, CAL.—The Southern Pacific Co. is reported to be again considering building a bridge across the Straits of Carquinez from Benicia to Port Costa.

BROCKVILLE, ONT.—A committee of the County Council has recommended that a new structure be built to replace the Otter Creek bridge.

BUTLER, MO.—Bids are wanted, July 8, by R. E. Johnson for five steel bridges from 40 to 60 ft.

CHERRY VALLEY, ILL.—Bids are wanted, July 8, by T. A. Healey, of this place, for a steel bridge about 320 ft. long, to cross the south branch of Kishwaukee River.

CHINOOK, MONT.—Bids are wanted, July 21, by the County Clerk for a bridge 200 ft. long, the cost of which is not to exceed $10,000. Bidders to submit plans. Albert W. Merrifield, County Surveyor.

COLUMBIA, TENN.—We are told that bids are wanted for a steel bridge about 1½ miles east of Columbia, to cross Duck River; $4,500 is appropriated. Address James Carr, member of the committee.

COLUMBUS, OHIO.—The railroad companies and the city have settled upon the cost to be borne by each in building two new bridges over the railroad tracks on Cleveland avenue. The Panhandle and the Baltimore & Ohio roads will pay about 65 per cent. of the south bridge and the Norfolk & Western and Cleveland, Akron & Columbus roads will pay for the north bridge.

CONCORDIA PARISH, LA.—Bids are wanted, July 14, for three steel bridges. J. P. Fagan, Vidalia, La.

CORNWALL, ONT.—The County Council has decided to build a new bridge to replace Sandy Creek bridge on the boundary between Grenville and Dundas.

DALTON, GA.—Bids are wanted, July 10, for a new bridge at the site of the old Tarver bridge. Joseph Bogle, Ordinary.

DANVILLE, VA.—The county officers will want bids soon for a bridge across Stuart's Creek, on the road between Vance and Danville.

FAIRMONT, MINN.—Bids are wanted by F. A. Patterson, chairman of the road committee, until 2 p. m., July 9, for building two bridge abutments.

FORT BENTON, MONT.—Bids are wanted, July 21, for a 200-ft. combination or Howe truss bridge over Milk Creek. E. F. Sayre, County Clerk.

HAMMOND, IND.—The House of Representatives on June 26, and the U. S. Senate on June 28, passed the bill authorizing the New York, Chicago & St. Louis Ry. Co. and the Chicago & Erie R. R. Co. to build a bridge across the Calumet River, at or near Hammond, Ind., about 1,200 ft. east of the Indiana and Illinois state line and 100 ft. east of the location of the present bridge of the N. Y., C. & St. L. across that river. Also, to authorize the Chicago & State Line R. R. Co. to build a bridge across said river where its line crosses said river in Hyde Park Township.

IOWA.—The U. S. Senate on June 23 passed the bill, previously passed by the House of Representatives and since signed by the President, authorizing a bridge across the Missouri River in Cass County, Neb., and Mills County, Iowa. (June 20, p. 484.)

KANSAS.—The U. S. Senate on June 19 passed the bill authorizing the Kansas City, Outer Belt & Electric Ry. to build a bridge across the Missouri River at a point within five miles of the Kaw River in Wyandotte County, Kansas, and Clay County, Missouri. The bill gives detailed dimensions for the bridge, the plans and construction for which are to be under the supervision and subject to the approval of the Secretary of War. If a drawbridge, it must be a pivot draw with one or more draw spans as the Secretary of War directs, and if a continuous span it must be at least 50 ft. above high water with a main channel span not less than 400 ft. in the clear. Work must commence within two years and the bridge be completed within four years. (June 13, p. 452.)

LEAKSVILLE, MISS.—The Alabama & Mississippi R. R., recently organized, will need a large bridge near Leaksville, Miss.

LEWISBURG, PA.—The County Commissioners will open bids on July 7 for the masonry of three bridges.

LITTLE FALLS, MINN.—The House of Representatives on June 26 passed the bill, previously passed by the U. S. Senate, authorizing the city of Little Falls, Minn., to build a wagon and foot bridge across the Mississippi River within the limits of the city. (May 16, p. 370.)

MILWAUKEE, WIS.—The City Engineer has sent a recommendation to the Council for a bridge across Milwaukee River at Clarke or Wright street, to cost about $125,000. The total length will be about 1,200 ft., of which 745 ft. will comprise the bridge proper.

MINNEAPOLIS, MINN.—Bids are wanted, July 7, by Hugh R. Scott, County Auditor, for three bridges.

MINNESOTA.—A bill has been passed by the U. S. Senate and House of Representatives authorizing the Minneapolis, Superior, St. Paul & Winnipeg Ry. to build and maintain a bridge across the Mississippi River. (June 13, p. 452.)

MISHAWAKA, IND.—A highway bridge 400 ft. long will be built over the St. Joseph River at this place, at a cost of about $40,000. A. J. Hammond, City Engineer of South Bend, Ind., will make the plans and superintend the work.

NEWARK, N. J.—It is said that plans for the bridge over Broad street for the Lackawanna track elevation have finally been decided upon.

NASHVILLE, ILL.—It is said the Commissioners of Washington and Clinton counties will soon want bids for a steel bridge to cost about $14,000.

PHILADELPHIA, PA.—Local reports state that engineers for the Philadelphia Rapid Transit Co. are making plans for the proposed subway in Market street between Broad street and the Schuylkill River. It is said that in connection with this subway a double-deck bridge will be built over the Schuylkill.

PIERRE, S. DAK.—The bill authorizing the Duluth, Pierre & Black Hills R. R. to build a bridge across the Missouri River at Pierre, S. Dak., was passed by the House of Representatives on June 27 and by the U. S. Senate on June 28. (May 9, p. 352.)

ROME, N. Y.—Bids are wanted, July 7, for building a bridge over the Mohawk at East Dominick street.

ST. LOUIS, MO.—The St. Louis & San Francisco is about to let contracts for 29 steel spans of various lengths up to 40 ft.; also two girder spans of 104 ft. each.

SAVANNAH, TENN.—We are told that there are three bridges to be built in Hardin County. The prices are about $2,500 each.

SCRANTON, MISS.—Bids are wanted, July 7, for a bridge on Lake avenue. F. H. Lewis, Clerk.

SOUTH CAROLINA.—The U. S. Senate on June 25 passed the bill, previously passed by the House of Representatives, authorizing two bridges across the Ashley River, in Charleston and Dorchester counties, S. C., to be built by the Charleston, Suburban & Summerville Ry. (May 16, p. 370.)

SYDNEY, NOVA SCOTIA.—J. A. L. Waddell, Consulting Engineer of Kansas City, Mo., has been engaged to take charge of the proposed bridge over the Straits of Canso, between Cape Breton and the mainland of Nova Scotia. Reports state the bridge will be a cantilever with a span about 1,800 ft. long.

TENNESSEE.—The bill authorizing the Harriman Southern Ry. to build a bridge across the Tennessee River in Tennessee, which was passed by the House of Representatives recently, has now been passed by the U. S. Senate and signed by the President. (June 20, p. 484.)

The House of Representatives on June 26 passed the bill, previously passed by the U. S. Senate, authorizing the Tennessee Central Ry. Co. to build a bridge across Emory River in Tennessee, near Harriman, Tenn. (April 25, p. 312.)

TIPTON, IND.—Bids are wanted, July 26, at noon, by the County Commissioners for 10 bridges of different lengths in various parts of the county. E. Perry, Auditor.

WASHINGTON, D. C.—The project for a Memorial Bridge across the Potomac River at Washington again failed of passage, being left out of the Sundry Civil bill in the House of Representatives.

WATERTOWN, N. Y.—C. O. McComb, City Engineer, tells us that the bridge proposed on Main street is to cross the Cape Vincent branch of the New York Central and also Cowins Creek. The cost is not to exceed $12,000.

WEST ELIZABETH, PA.—The bill authorizing the West Elizabeth & Dravosburg Bridge Co. to build a bridge across the Monongahela River, in Allegheny County, Pa., was passed by the House of Representatives on June 27 and by the Senate on June 26. (March 28, p. 234.)

WINCHESTER, IND.—The County Commissioners have rejected the bids for the eight county bridges opened on June 21. New bids are wanted. Geo. Warner, Chairman.

Other Structures.

AKRON, OHIO.—It is said that plans for the Cleveland, Akron & Columbus freight station in this city are with President McCray awaiting approval.

CLEVELAND, OHIO.—The Erie R. R. is reported to have taken title to 250 acres of land at Randall, near Cleveland, for new terminals, freight yards and shops.

COLUMBUS, OHIO.—The contract for the machine shops and a roundhouse of brick and steel, to be built at Columbus, has been let by the Pennsylvania Co. to the Pittsburgh Construction Co., at a cost of $500,000. The shop will be 80 x 660 ft. and the roundhouse will have 44 stalls. It is said that two large cranes and considerable electrical machinery will be needed for the shop.

CUYAHOGA FALLS, OHIO.—The contract for the two 25-ton furnaces for the Ohio Steel & Iron Specialty Co. has been let to the Garrett-Cromwell Engineering Co., of Cleveland.

DANVILLE, ILL.—The Chicago & Eastern Illinois, according to report, has decided to locate its new shops in Danville.

FORT WAYNE, IND.—The Pennsylvania Co. has let the contract for the new machine shop to E. W. Spoul, of Chicago, and work is to be begun at once. The shop will be 600 x 80 ft. (May 23, p. 384.)

FORT WORTH, TEX.—An officer of the International & Great Northern writes us that the work proposed at Fort Worth consists of building a small roundhouse and the necessary repair shop. The company's facilities at that point at the present time are not expected to be very large as the engines will not be held at Fort Worth any length of time. The roundhouse will have five or six stalls.

GULFPORT, MISS.—We are told that the Gulf & Ship Island Ry. is building a 60 x 304 ft. extension to its car shops, and in addition to this will build a planing mill 60 x 80 ft.; also a paint shop, 40 x 200 ft., all frame, the approximate cost being $10,000. The company also expects to build a machine shop at Hattiesburg, Miss., 40 x 80 ft.; a 7-stall roundhouse, with a 66-in. turn-table of 152 tons capacity. It will also put up a water tank and car shed 40 x 200 ft., and build a yard containing about three miles of track.

LANSING, MICH.—The Grand Trunk, according to report, has plans made for a new passenger station in this city. The building will be 44 x 150 ft., and will be built of stone and brick, the estimated cost being $36,000.

MERIDIAN, MISS.—The Mobile & Ohio and the Southern are to build a joint freight station in this city. The plans are now being made.

MISSOULA, MONT.—The contract for the new shops of the Northern Pacific at this city has been let to Messrs. Hastie & Dugan, of Spokane.

NEW BRUNSWICK, N. J.—The contract for building the factory for the National Boiler Tube Co. has been let to the H. Wales Lines Co., of Meriden, Conn., at $30,000. The building will be 75 x 225 ft.

NEW FREEDOM, PA.—It is said that the Northern Central Ry. contemplates building small repair shops near this city.

NORFOLK, VA.—Local reports state that railroads entering the city have agreed upon building a costly union passenger station. The roads said to be interested are the Norfolk & Western, the Seaboard Air Line, the Atlantic Coast Line, the Southern, the Norfolk & Southern, and the Chesapeake Transit Co.

PEORIA, ILL.—It is said that the Peoria & Pekin Union has made an appropriation for a 33-stall roundhouse in this city.

PITTSBURGH, PA.—Negotiations are said to be pending for the consolidation of three independent steel companies with the Burns Uniform Steel & Metallic Co., recently organized. This company recently let contracts for the construction of its plant at Cassatt, east of Latrobe, Pa. The names of the companies which are proposed to consolidate have not been learned.

POTTSVILLE, PA.—It is said that the Pennsylvania R. R. will control the Pottsville Iron & Steel Works, which will soon be put in operation after an idleness of five years.

ST. PAUL, MINN.—The St. Paul Terminal & Transfer Co. will build a two-story brick freight house on Fillmore avenue, West St. Paul, to be used by the Chicago, Rock Island & Pacific. Contract is let to P. M. Hennessy, of St. Paul, at $58,000. The building is 48 ft. wide and 500 ft. long.

SAN FRANCISCO, CAL.—It is said that all details are arranged for building the passenger station by the Santa Fe and the Oakland Transit Co., in Oakland; also for the Ferry service between Oakland and San Francisco.

SAVANNAH, GA.—Local report says that the shops of the Plant System will not be removed from Savannah on account of the consolidation of the Plant System and the Atlantic Coast Line, but there is a belief that the present shops will be extended.

SEATTLE, WASH.—A plant to cost about $300,000 to make and repair locomotives and freight cars will be built at Ballard by a company to be known as the Ætna Locomotive & Machine Co. E. C. Hawkins is president and Geo. J. Danz is Secretary and Treasurer.

TUSCUMBIA, ALA.—The new shops of the Southern, near this city and Sheffield, have been finished by contractors J. P. Elliott & Co., of Hickory, N. C. The plant consists of a wood-working and car erecting shop, paint and upholstering building, sand house and repair shop.

WAUKESHA, WIS.—The Waukesha Sheet Steel Co., according to report, contemplates building a corrugating plant, also an open-hearth furnace.

WAYCROSS, GA.—It is said local capitalists propose to build a plant in this city to make box and flat cars. It is said certain officers of the Atlantic & Birmingham are interested.

WILMINGTON, DEL.—According to local reports, the Pennsylvania R. R. has plans ready for the new shops to be built on the Shellpont branch near Wilmington.

YOUNGSTOWN, OHIO.—A despatch from this place says that independent furnace operators of the Mahoning Valley contemplate building a large Bessemer steel plant in the western part of this city, on the other side of the river from the Ohio plant of the National Steel Co. The principal concerns interested are the Brier Hill Iron & Coal Co. and the Youngstown Steel Co. Julian Kennedy is said to be preparing the plans.

MEETINGS AND ANNOUNCEMENTS.

(For dates of conventions and regular meetings of railroad associations and engineering societies see advertising page xviii.)

American Association for the Advancement of Science.

The following is the programme for the meeting at Pittsburgh June 28-July 3, 1902. Section D, Mechanical Science and Engineering. The list of papers is provisional, and subject to change, at the hands of the Sectional Committee.

Monday, June 30.—The Section will meet for organization immediately after the adjournment of the morning General Session. The place of meeting will be the lecture room of the First United Presbyterian Church.

Tuesday, July 1.—Beginning on this day, the following papers will be presented:

1. The trend of progress in prime movers. Director R. H. Thurston, Cornell University.
2. On changes in form as an essential consideration in the theory of elasticity. Mr. Frank H. Cilley, Brooklyn.
3. On the advantage of siamesed hose lines for fire steamers. Professor Mansfield Merriman, Lehigh University.
4. The nomenclature of mechanics. Professor R. S. Woodward, Columbia University.
5. U. S. work in the Ohio, Allegheny and Monongahela Rivers near Pittsburgh. Mr. Thomas P. Roberts, Pittsburgh.
6. On a type of planetary orrery using the mechanical principle of the conical pendulum. Professor David P. Todd, Amherst College.
7. On the ratio of the transverse to the longitudinal elastic strain produced by longitudinal stress. Professor Thomas Gray, Rose Polytechnic Institute, Terre Haute, Ind.
8. On the effect of hardening steel on its Young's Modulus. Professor Gray.
9. A test of a ball thrust bearing. Professor Gray.
10. A new photometer, with exhibition of the instrument. Professor C. P. Matthews, Purdue University.
11. The mechanics of reinforced concrete beams. Professor W. K. Hatt, Purdue University.
12. Some experiences with a simple Babbitt testing machine. Mr. E. S. Farwell, New York City.
13. The rules and regulations concerning air-ship contests at the Louisiana Purchase Fair. Professor C. M. Woodward, Washington University, St. Louis.
14. Long distance electric transmission regarded as a hydrodynamic phenomenon. Professor H. T. Eddy, University of Minnesota.
15. The effect of weeds and moss upon the coefficients of discharge in small irrigating canals. Prof. J. C. Nagle, College Station, Texas.

It is expected that an evening illustrated stereopticon lecture will be given before this section by Capt. Sebring upon the bridges and other interesting structures of the Philippines. The first excursion of the Section will probably be on Tuesday afternoon, July 1, to the Carnegie Homestead plant. Other excursions to similar points are arranged and will be available to the members of the Section to any extent desired.

PERSONAL.

—At the Commencement ceremonies at Yale University, on Wednesday of last week, Mr. H. G. Prout, Editor of the *Railroad Gazette*, received the honorary degree of Master of Arts. He is a graduate of the University of Michigan, from which institution he received the degree of Civil Engineer.

—Major Ira A. Shaler, the contractor who was injured on June 17 last, by the falling of a fragment of rock in the rapid transit subway, in Park avenue, New York City, died June 29. A brief sketch of Major Shaler's life appeared in our issue of June 20, a few days after the accident, and will be found on page 485.

—Mr. Norman Beckley, at one time General Agent of the Cleveland, Cincinnati, Chicago & St. Louis, died at Elkhart, Ind., June 23, at the age of 79 years. Mr. Beckley entered railroad service in 1845 and was connected with various railroads until 1878, when he became General Manager of the Cincinnati, Wabash & Michigan. He became General Agent of the Big Four in 1892.

—Captain M. G. Howe, who was at one time Chief Engineer of the Houston & Texas Central, died June 19. He was born at Methuen, Mass., in 1834, and was graduated from Dartmouth College. In 1859 he went to Houston and entered the service of the Houston & Texas Central in the engineering department. Captain Howe served in the Confederate Army, reaching the rank of Captain. After the war he re-entered the service of the Houston & Texas Central and held the positions of Chief Engineer, Division Superintendent and General Superintendent. He continued in these capacities until 1885, when he was made Receiver of the Houston East & West Texas. After the road passed from under the Receivership, he became its Vice-President and General Manager, which position he retained until 1897, when ill health compelled him to retire. About two years later he became Chief Engineer of the Houston & Texas Central, but continued ill health again compelled him to resign.

ELECTIONS AND APPOINTMENTS.

Atchison, Topeka & Santa Fe.—There is still no official information of Mr. Kendrick's decision in the matter of the Westinghouse offer. Recent rumor says that he has declined and will stay with the Atchison, which is not at all improbable.

J. F. Mitchell has been appointed Ticket Auditor, succeeding C. M. Atwood, Auditor of Passenger Receipts, resigned.

Atlanta, Knoxville & Northern.—At a meeting of the Directors held June 14, the following officers were elected: President, Milton H. Smith, succeeding H. K. McHarg, resigned; Vice-President, J. B. Newton, succeeding the late E. C. Spalding; Assistant Secretary, J. H. Ellis, and Assistant Secretary, V. L. Smith.

Atlantic Coast Line.—Since July 1, the Atlantic Coast Line has been operated in two divisions, to be known as the First and Second Divisions. The First Division will comprise all of the roads north of Charleston, S. C., which prior to July 1, constituted the Atlantic Coast Line Railroad; the Second Division will comprise all of the roads south of Charleston, S. C., which formerly constituted the Plant System of Railways. The First Division embraces the following nine districts, which were formerly called divisions: Richmond, Short Cut, Charleston, Wilmington, Yadkin, Columbia, Norfolk, Florence and Augusta. The Second Division embraces the following districts, which were formerly called divisions: First, Second, Third, Fourth, Fifth and Sixth. Local Superintendents, who formerly had the title of "Division Superintendent," will hereafter be called "District Superintendent." W. N. Royall has been appointed General Superintendent and John F. Divine Assistant General Superintendent of the First Division, with headquarters at Wilmington, N. C. G. M. Serpell retains the position of General Superintendent of the Norfolk District at Norfolk, Va. G. G. Lynch has been appointed Superintendent of the Charleston District of the First Division, at Charleston, S. C., and the jurisdiction of F. H. Fechtig, Purchasing Agent, and R. E. Smith, Assistant to the General Manager, has been extended over the Second Division. W. B. Denham retains the position of General Superintendent of the Second Division, at Savannah, Ga.

H. M. Emerson has been appointed Assistant Traffic Manager. R. A. Brand has been appointed General Freight Agent, with headquarters at Wilmington, N. C., and James Menzies becomes General Freight Agent, at Savannah, Ga., and W. J. Craig becomes General Passenger Agent, at Wilmington, N. C., and J. W. Perrin, Assistant General Freight Agent.

Blackwell, Enid & Southwestern.—The headquarters of S. Dunn, Vice-President and General Manager, have been removed from Blackwell, Okla. T., to Cordell, Okla. T.

Brooklyn Rapid Transit.—The following gentlemen have resigned: B. F. Folger, Superintendent of the Elevated Lines; R. Fay, Assistant Superintendent of Elevated Lines; G. E. Lyons, General Trainmaster, and C. Robson, General Inspector. G. W. Edwards succeeds Mr. Folger as Superintendent of the Elevated Lines.

Burlington & Missouri River in Neb.—The Kansas City & Omaha Railway lines from Alma to Stromsburg have since June 30, been operated as a part of the Northern Division, with E. Bignell, Superintendent, at Lincoln, Neb., in charge; and the lines from McCool Junction to Kansas City & Omaha Junction, north of Fairbury, have been operated as part of the Southern Division, with C. B. Rodgers, Superintendent, at Wymore, Neb., in charge. (See Railroad News column.)

Central of Georgia.—W. D. Beymer has been appointed Auditor, with headquarters at Savannah, Ga., succeeding H. A. Dunn, resigned, effective July 1.

Central Vermont.—W. E. Mullins has been appointed Superintendent of Transportation, with headquarters at St. Albans, Vt., effective July 1.

Chesapeake & Ohio.—C. C. Dunn has been appointed Division Engineer of the Huntington Division, with headquarters at Hinton, W. Va., succeeding E. T. Morris, resigned.

Chicago & North Western.—R. H. Aishton has been appointed Assistant General Manager and is succeeded as General Superintendent by W. D. Cantillon, heretofore Assistant General Superintendent, effective July 1. Thomas A. Lawson, Superintendent of the Wisconsin Division, succeeds Mr. Cantillon as Assistant General Superintendent. F. R. Pechin, heretofore Superintendent of the North Iowa Division, succeeds Mr. Lawson at Chicago. W. D. Beck, Assistant Superintendent, succeeds Mr. Pechin at Eagle Grove, Iowa, and Mr. Beck in turn is succeeded by G. W. Dailey, heretofore Trainmaster.

Chicago Great Western.—Charles O. Kalman has been appointed Assistant Auditor, with headquarters at St. Paul, Minn., effective July 1.

Chicago, Rock Island & Pacific.—J. Sebastian, heretofore General Passenger Agent, has been appointed Passenger Traffic Manager, with headquarters at Chicago, Ill.

Choctaw, Oklahoma & Gulf (Chicago, Rock Island & Pacific).—Henry Wood, Vice-President, has resigned. The jurisdiction of F. A. Marsh, General Purchasing Agent of the C., R. I. & P., has been extended over the C., O. & G. R. H. Hudson, Auditor of the Rock Island & Peoria, has been appointed Auditor of the C., O. & G., with headquarters at Little Rock, Ark.

R. E. Cahill, heretofore Division Superintendent of the Missouri Pacific, has been appointed General Superintendent of the C., O. & G., succeeding J. H. Harris.

Illinois Central.—H. McCourt, Division Superintendent, with headquarters at Chicago, Ill., has resigned.

Kansas City & Omaha.—See Burlington & Missouri River in Neb.

Kansas City Southern.—J. A. Hanley, Freight Traffic Manager, with headquarters at Kansas City, Mo., has resigned.

Maine Central.—Charles H. Venison having resigned as Master Car Builder, the jurisdiction of Philip M. Hammett, Superintendent of Motive Power, has been extended over the Car Department, effective July 1.

Mexican Central.—The headquarters of A. A. Robinson, President, have been removed from Boston, Mass., to St. Louis, Mo.

Minneapolis, St. Paul & Sault Ste. Marie.—At a meeting of the Board of Directors held recently the following two new Directors were elected: E. A. Young and G. R. Newell.

Missouri, Kansas & Texas.—R. R. Hammond, heretofore Superintendent of Maintenance of the St. Louis & San Francisco, has been appointed Assistant General Manager of the M. K. & T., with headquarters at St. Louis, Mo.

Missouri Pacific.—S. Ennes has been appointed Division Superintendent, with headquarters at Nevada, Mo., succeeding R. E. Cahill, resigned. (See Choctaw, Oklahoma & Gulf.)

New York Central & Hudson River.—William Kleefield, Jr., has been appointed Supervisor of Bridges on the Middle Division, with headquarters at Utica, N. Y., effective July 1.

New York, Texas & Mexican.—T. A. Duff is Acting Auditor and will probably be appointed Auditor to succeed G. R. Cottingham, who is to be transferred to Houston.

Oregon R. R. & Navigation.—J. W. Newkirk has been appointed Assistant Treasurer, succeeding G. E. Withington, deceased.

Philadelphia & Reading.—R. Atkinson has been appointed Master Mechanic, with headquarters at Reading, Pa., effective July 1.

St. Louis & San Francisco.—Robert Rennie, heretofore Master Mechanic of the Delaware & Hudson, has been appointed Mechanical Engineer of the St. L. & S. F., with headquarters at Springfield, Mo., effective July 1.

R. R. Hammond, Superintendent of Maintenance, with headquarters at Springfield, Mo., has resigned. (See Missouri, Kansas & Texas.)

W. C. Squire, Mechanical Engineer, with headquarters at Springfield, Mo., has resigned.

St. Louis, Memphis & Southwestern.—C. M. Hunt has been appointed General Superintendent, in charge of the lines Cape Girardeau, Mo., to Hoxie, Ark., and Mingo, Mo., to Hunter, Mo. W. G. Tiffany, heretofore Acting Superintendent of the Hoxie Branch, has been appointed Superintendent of the Memphis Division, succeeding Mr. Hunt, effective July 1.

Southern.—The jurisdiction of H. L. Fry, Resident Engineer, will cover the lines between Monroe and Spencer, Greensboro, and Goldsboro, Rocky Mount, Chapel Hill and Asheboro branches.

RAILROAD CONSTRUCTION.

New Incorporations, Surveys, Etc.

ASHEVILLE & RUTHERFORDTON.—Contract has been let to Geo. T. Cauls, of New York, to build this projected line from Asheville, N. C., to Rutherfordton, a distance of 40 miles. The necessary surveys are said to have been made.

ATCHISON, TOPEKA & SANTA FE.—It is said that work will begin at once on the projected line from Portales, on the Pecos Valley & Northeastern in New Mexico, across to Albuquerque, in the central part of the territory, a distance of about 190 miles. Preliminary surveys were made for this route last May without definite indications of building. (May 2, p. 335.)

BELLINGHAM BAY & BRITISH COLUMBIA.—Bids were asked June 20 for the first eight miles of the extension which is to be built from Maple Falls, Whatcom County, Wash., across the Cascade Mountains to Methow. Location of the line beyond Glacier Creek is now in progress, and it is said that the construction work will be completed by winter. (April 11, p. 227.)

CANADIAN PACIFIC.—Surveys are reported on three projected lines for a cut-off between the Pontiac-Pacific Junction, which is now under the control of the Canadian Pacific, and the main line, to make connection either at Renfrew, Cobden or Pembroke. The alleged reason for the cut-off is to shorten the distance for the transcontinental trains. It is said that work will begin as soon as the route is decided on.

It is said that an extended inspection of the Ontario & Quebec Division has just been finished by the General Manager and Chief Engineer and with a result that work is to begin at once on the reduction of grades previously mentioned, bids for a portion of which have already been called for. (May 2, p. 335.)

CARNEGIE & MCDONALD STREET (ELECTRIC).—An officer writes that surveys have been made for this electric line from Carnegie, Pa., to Walkers Mills, Oakdale, Noblestown, Sturgeon and McDonald, 10 miles, and that bids will be asked for as soon as the financial details are completed. The work will not call for any steel bridges. J. W. Nesbit, Oakdale, Pa., is President. (June 13, p. 453.)

CARTHAGE & WESTERN.—This company was chartered in the interest of the Missouri Pacific June 19, with a capital stock of $270,000. It will run from Carthage to Ashbury, Jasper County, Mo., 18 miles. The incorporators are Geo. J. Gould, Russell Harding and other officers of the Missouri Pacific.

CHATTANOOGA SOUTHERN.—An officer writes relative to the report that the road will be extended to a connection with the East & West, that the matter has been talked of but is still indefinite, and no information can be given at the present time.

CHICAGO, MILWAUKEE & ST. PAUL.—An officer denies current press reports that an extension is to be built into Montana for which surveys are being made at the present time.

CHOCTAW, OKLAHOMA & GULF.—Contract is reported awarded to J. Johnson & Co. to grade a line 11 miles long from Nocona to Montague, Texas. E. E. Churchill, of Fort Worth, is General Manager.

CINCINNATI, GEORGETOWN & PORTSMOUTH.—Contract has been let to the Tennis Railway Equipment Co. to convert the motive power of this railroad, which runs from Cincinnati to Georgetown, Ohio, 42 miles, from steam to electricity. At present the road operates 39 miles of narrow gage line and three miles of standard gage line, but announcement was made last winter that there was likelihood of converting the entire line to standard gage.

DENVER & NORTHWESTERN.—According to most recent reports, grading is completed on the extension from Arvada, Colo., to the Leyden Creek coal mines, a distance of 10 miles. It is said that a line will also be built from Leyden to Hot Sulphur Springs, 80 miles beyond, and contracts for this will be let some time during the summer.

DETROIT SOUTHERN.—It is said that bids have been asked for the proposed extension from Jackson to Ironton, Ohio, an air line distance of 35 miles. All necessary surveys for the line are said to be completed and work is to begin as soon as the contracts are let. When completed this link will be a portion of a through line from Detroit, Mich., to the Ohio River.

EAU CLAIRE, CHIPPEWA FALLS & NORTHEASTERN.—According to most recent advices, a large force of men is now at work on this extension, which is being built for the Chicago, St. Paul, Minneapolis & Omaha. According to present indications, 28 miles of the line will be in operation this fall. The general contract was let to Winston Bros., of Minneapolis. (June 20, p. 485.)

FAIRHAVEN & GEORGETOWN.—Surveys are reported for a railroad from Six-mile Ferry through Allegheny and Beaver counties to Georgetown, Pa., 45 miles. L. D. Barns, of Pittsburgh, Pa., is the Engineer in charge.

FREMONT, ELKHORN & MISSOURI VALLEY.—The branch from Verdigre, Neb., which was reported located for 70 miles north and west last winter, has been completed as far as Niobrara, 12 miles. Winston Bros., of Minneapolis, were the contractors.

GREAT FALLS & CANADA (GREAT NORTHERN).—Contracts for standard gaging portions of this line, which starts at Great Falls, Mont., and runs into Canada, have been let to Peter Sems and L. Shields, of St. Paul. Contracts have been sub-let to Wm. Winters for 12 miles; Twohey Bros., of Anaconda, for 12 miles, and James Caugbraugh for four miles. The Great Falls & Canada is 200 miles long and was sold last year to the Great Northern.

GREAT NORTHERN.—Maps were filed in the Land Office at Kalispell, Mont., June 17, of the location of the survey of the proposed extension of the Montana & Great Northern branch which will leave the main line near Columbia Falls Station, Mont., and run northwest touching the west shore of White Fish Lake, to a point six miles south of the International boundary, where it turns southwest about two miles and connects with the Jennings branch of the Great Northern. It is not known when contracts for this extension are likely to be let. The Montana & Great Northern was incorporated in June, 1901, to build from Jennings, Mont., north to the Canadian boundary, and thence into the Crows Nest country.

Surveys are reported completed on the Kalispell-Jocko cut-off, and it is reported that work on this line will be begun during the present year. The length of the proposed line is about 65 miles and surveys were commenced last February.

INDIANAPOLIS, BLOOMINGTON & BEDFORD STONE.—An officer writes that there is no likelihood that this road will be built for the present, as the Indianapolis Southern has agreed to build to the quarries which were to have been reached. It was projected from Bloomington through Victor to Switz City, Ind., a distance of about 40 miles.

INTERCOLONIAL.—The proposed branch from Riviere Ouelle Station to the wharf opposite Murray Bay on the Saguenay River, is already located and surveys completed. It is said that the work will be rushed so as to be completed during the summer, in order to obtain a share of tourist traffic this year. A steamer to cross the river will be run in connection with this branch line. (May 16, p. 372.)

JAMES RIVER.—This company was organized at Portsmouth, Va., June 21, to operate under a charter previously obtained, and build a railroad from Portsmouth to the West Virginia line through Smithfield, Suffolk and Richmond. The promoters are Messrs. Maynard, Wool, Phillips & Watson, who are interested in the Norfolk, Portsmouth & Newport News R. R., and are said to be affiliated with the Williams banking interest in Richmond. The line was originally incorporated in April, 1900, and surveys were made, but nothing further was done. John L. Watson, Portsmouth, Va., may be addressed.

KNOXVILLE, KIMBERLIN HEIGHTS & SEVIERVILLE ELECTRIC.—Work was begun a trifle over a week ago on surveys for this projected line, which will run from Knoxville to Sevierville, Tenn., a distance of 27 miles, with branch lines to the Ross marble quarry, Kimberlin Heights and also eight miles up the east or west prongs of the Pigeon River, reaching a country rich in marble and timber. The total estimated length of the line is 50 miles. M. F. Flenniken is Vice-President, and E. N. Harris, of Knoxville, is Chief Engineer. (Nov. 15, 1901, p. 798.)

LICK CREEK & LAKE ERIE.—Track laying is reported begun on this new line from St. Paul, Va., up Lick Creek to Turkey Foot, eight miles. The line is projected to reach coal properties in the Sandy Mountains between Clinch River and Big Sandy River, and J. W. Dawson, of St. Paul, Va., is Manager.

LOUISIANA ROADS.—Surveys are reported completed and location made for a railroad from Donaldsonville, La., to Napoleonville, 12 miles, exclusive of several spurs to reach plantations and mills along the line. It is reported that funds are coming in in sufficient amount so that it is expected that the line will be built this summer. There are 11 sugar mills along the road which will require some nine miles of spur track. M. D. Bringier is the promoter.

It is said that a railroad six miles long will be built by business men of Arcadia, La., from that place to a connection with the Louisiana & Northwestern.

MADRID (MAINE.)—This company filed articles of association with the Maine Railroad Commissioners June 21, for a narrow gage road from Phillips to Township

in Franklin County, 6½ miles. The capital stock is $21,-000, and the directors are Fletcher Pope, S. G. Haley, J. H. Byron and others, of Phillips, Me.

Manchester, Dorset & Granville.—This company has been chartered in Vermont to build a railroad from Manchester to Dorset, Vt., and Granville, N. Y., a distance of about 21 miles. It is thought that the section between Manchester and Dorset, Vt., eight miles, will be built before winter.

Marion & Rye Valley.—Surveys are reported completed for an extension from Currin Valley, Va., to Flat Ridge, a distance of 14 miles, and it is said that grading will begin shortly. John S. Apperson, Marion, Va., may be addressed.

Middlebrook & Graniteville.—This company has been incorporated in Missouri to build from a point above Middlebrook, on the St. Louis, Iron Mountain & Southern, to Graniteville, three miles west. The incorporators are: W. R. Allen and others of St. Louis, and W. R. Allen, Jr., and S. T. Walsh, of Graniteville.

Missouri Pacific.—Incorporation has been granted in Missouri to the Carthage & Western, capitalized at $270,-000, to build from a point on the Lexington & Southern Division of the Missouri Pacific at or near Carthage, to a point at or near Asbury, 18 miles. Bids have been asked for this line and surveys are reported made. The incorporators are directors of the Missouri Pacific.

Montana Roads (Electric).—A company has been incorporated with headquarters at Bozeman, Mont., to build an electric road from that place to Salesville and up the West Gallatin Canyon to Yellowstone Park, a distance of about 80 miles. A large power plant is to be built to be operated by water power and it is the intention of the incorporators to eventually build other lines throughout the vicinity.

Monticello, Fallsburg & White Lake.—According to most recent reports, the seven-mile strip of this line between Fallsburg and Monticello, N. Y., will be opened for business in August. Work is reported under way on a 13-mile section between Monticello and White Lake which it is thought will be completed in November. The road is so built that it can be operated either by steam or electricity.

New Brunswick Coal & Railway.—Contract has been let to the Barnes Construction Co. to build an extension from the New Castle coal fields, N. B., to Gibson, on the Canada Eastern, a distance of 30 miles. It is said that work will be begun at once. Contract was let to the Barnes Co. for the first section of this extension from Chipman to New Castle, 15 miles, last winter. (Construction Supplement, March 14, 1902.)

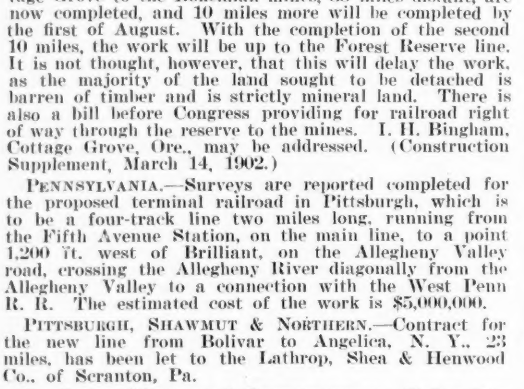
New Orleans, Natalbany & Natchez.—This company has been incorporated in Louisiana to build from Natalbany northwest to East Feliciana and through Mississippi to the Mississippi River. The incorporators are C. B. Young, G. H. Richey and others.

Oregon Roads.—According to most recent advices, 10 miles of what is known as the Bohemia R. R. from Cottage Grove to the Bohemian mines, 35 miles distant, are now completed, and 10 miles more will be completed by the first of August. With the completion of the second 10 miles, the work will be up to the Forest Reserve line. It is not thought, however, that this will delay the work, as the majority of the land sought to be detached is barren of timber and is strictly mineral land. There is also a bill before Congress providing for railroad right of way through the reserve to the mines. I. H. Bingham, Cottage Grove, Ore., may be addressed. (Construction Supplement, March 14, 1902.)

Pennsylvania.—Surveys are reported completed for the proposed terminal railroad in Pittsburgh, which is to be a four-track line two miles long, running from the Fifth Avenue Station, on the main line, to a point 1,200 ft. west of Brilliant, on the Allegheny Valley road, crossing the Allegheny River diagonally from the Allegheny Valley to a connection with the West Penn R. R. The estimated cost of the work is $5,000,000.

Pittsburgh, Shawmut & Northern.—Contract for the new line from Bolivar to Angelica, N. Y., 23 miles, has been let to the Lathrop, Shea & Henwood Co., of Scranton, Pa.

St. Louis, Memphis & Southeastern.—Under date of July 1, the opening of the Pocahontas extension from



Harviell to Pocahontas, Ark., 42 miles, is announced. Announcement is also made that the Hoxie, Pocahontas & Northern, recently acquired, will hereafter be operated as the Hoxie Branch, extending from Pocahontas, Ark., to Hoxie, 15 miles. The St. Louis, Memphis & Southeastern was organized under the laws of Missouri Jan. 8, 1902, with an authorized capital of $12,500,000, to take over the Cape Girardeau & Northern, the Southern Missouri & Arkansas, the Hoxie, Pocahontas & Northern, the St. Louis & Memphis, and a portion of the Chester, Perryville & Ste. Genevieve. The work also includes 154 miles of new line and contracts were let to Johnston Bros. The project, when completed, will give a total of 420 miles and a main line from St. Louis to Luxora, Ark., which will form a connection with the St. Louis & San Francisco, the shortest route between Birmingham, Memphis and St. Louis. The accompanying map shows the details of the system. The directors are: F. H. Prince and Frederick Ayer, of Boston; Newman Erb and E. Summerfield, of New York, and others. (Feb. 28, p. 154.)

Santa Clara Valley (Electric.)—This company is reported to have sold its holding to J. Burson and it is the intention of the purchaser to make the line a continuation of the Bakersfield-Sespe line to tidewater at Hueneme, Cal. Conditions of the sale are that work must begin within 60 days and be completed within six months. The line will be about 115 miles long, if built as planned, and power will be furnished by the large plant now building at Oxnard, Cal.

Seaboard Air Line.—Surveys are reported in progress for the projected entrance into Birmingham, Ala., which is to be built from Coal City, on the East & West R. R. of Alabama, to run north of Branchville, crossing Oak Ridge at Elbow Gap, and running down the Coosa Valley along the east prong of Black Creek, crossing at Martin's Ford and running thence east toward Birmingham, a distance of about 45 miles. The East & West R. R. was purchased recently to serve as a link, but it will be necessary to practically rebuild it for heavy traffic. (June 6, p. 422.)

Southern Pacific.—The new line from Gueydan to Lake Charles, La., is said to be definitely located, passing around the lower end of Lake Arthur, a distance of about 50 miles. Track laying was reported completed last spring between Abbeville and Gueydan, 25 miles. (April 25, p. 316.)

Suffolk & Carolina.—Plans are said to be completed to extend and improve this line, which is in operation between Suffolk, Va., and Mavaton, 41 miles. The idea of the syndicate is to create a new short cut to Pamlico Sound. The improvements include an extension to Edenton, N. C., and to Elizabeth City, N. C., a total of about 40 miles, and also the broad gaging of the present line. W. H. Bosley, of Baltimore, is President.

Tallahatchie.—This company is seeking charter for a railroad to be built from a point on the line of the Alabama & Vicksburg, five miles east of Chunkey Station, north along the line between Newton and Lauderdale counties, to Philadelphia, in Neshoba County, and thence to Louisville in Winston County, Miss., a distance of about 65 miles. The line is intended primarily as a logging road, but will carry freight and passengers as well. The incorporators are R. W. Meehan and others, of Milwaukee; S. R. Rounds, of Lauderdale; J. H. Wright, of Meridian, and others.

Tuxpan Valley.—Concession for a railroad 70 miles long in Mexico from Tuxpan to a point at or near Jalbonera, on the projected Tampico line of the Mexican Central, is reported let to C. B. Ames, of St. Louis. Geo. W. Deits, of the City of Mexico, is General Manager.

Velasco Terminal.—It is said that this line will be extended from its present terminus at Chenango, Texas, to Duke, 22 miles, passing between the Brazos River and Oyster Creek. It is not stated when work is likely to commence, or when any contracts will be let. I. H. Kempner, of Galveston, Texas, may be addressed.

Victoria, Vancouver & Eastern.—The branch between Cascade and Carson, B. C., 12 miles, is reported completed. This forms a link in the Great Northern system and on July 1 a regular passenger service was inaugurated between Spokane and Republic.

West Virginia Central & Pittsburgh.—Contract for a three-mile branch up Abram's Creek, W. Va., near Piedmont, is reported let and it is said that the work will be completed within three months.

Wichita Valley.—Announcement is made that the projected extension from Seymour to Stamford, Texas, about 75 miles, is to be temporarily abandoned because of the refusal of the citizens of Wichita Falls to subscribe $30,000 and the right of way for the northern extension of the line. It was proposed to build also from Wichita Falls about 20 miles north to a point on the Red River. Morgan Jones, Wichita Falls, is President. (May 16, p. 372.)

Windsor, Sandwich & Amherstburg (Electric).—It is said that this new line in Ontario will be extended at once to Amherstburg, a by-law granting the road $10,000 having been passed in Amherstburg on June 17. The length of the line will be about 22 miles when it is completed.

GENERAL RAILROAD NEWS.

Arkansas Valley Western.—A first mortgage for $3,-500,000, payable in 50 years and bearing interest at 4 per cent., has been filed in Oklahoma with the St. Louis Union Trust Co. as trustee. The line is now being built from Tulsa, Ind. T., to Enid, Okla. T., 175 miles, and was chartered in January, 1902. (Construction Supplement, March 14, 1902.)

Bruce Mines & Algoma.—A special meeting of the shareholders has been called by L. C. Holden, Secretary, to obtain authority to issue $250,000 bonds, to be secured by mortgage on the road, plant, rolling stock and franchise. The purpose to which the funds raised will be applied is not stated.

Central Ontario.—This road, the main line of which runs between Picton and Coe Hill, Ont., and which operates about 130 miles total, will be sold under foreclosure in Toronto on Sept. 13. The proceedings were undertaken for $2,200,000 under the mortgage of 1882, and the Toronto General Trust Corporation is trustee of the mortgage.

Chicago, Burlington & Quincy.—On and after July 1, the Kansas City & Omaha, which has previously been operated under a traffic agreement with the St. Joseph & Grand Island, will be operated by the Chicago, Burlington & Quincy, and under the jurisdiction of the officials of the Burlington & Missouri River R. R. in Nebraska. The Kansas City & Omaha runs from Stromsburgh to Fairfield, Neb., 64 miles; from McCord Junction to the K. C. & O. junction, Fairburg, Neb., 44 miles, and from Alma Junction, Fairfield, to Alma, Neb., 86 miles, a total of 194. It was organized in September, 1896, as successor to the old Kansas City & Omaha Co., whose property was sold under foreclosure in July, 1896.

Chicago, Rock Island & Pacific.—Collateral trust 4 per cent. bonds of 1902 (Choctaw collateral) have been listed by the New York Stock Exchange to the extent of $23,520,000, and the listing of further amounts in exchange for Choctaw, Oklahoma & Gulf stock has been authorized, the total amount not to exceed $24,-000,000. The Choctaw stock consists of $6,000,000 preferred, and $9,827,500 common, out of $10,000,000 authorized, and the majority of this is owned by the Rock Island. The $480,000 unissued bonds are reserved to be issued at 96½ to exchange for outstanding shares, at a rate not to exceed $60 per $50 share for the preferred, and $80 for a $50 share for the common.

Cleveland Street Railroads.—The Circuit Court on June 21 granted a perpetual injunction against the building of the so-called "Three-cent Fare Street Ry." in Cleveland, on the ground that the ordinance granted by the City Council was invalid. The original ordinance called for bids on 17 separate lines aggregating 75 miles, and the franchise granted by the Council covered lines which aggregate only 13 miles, i.e., three of the proposed 17 routes, presumably the most desirable. The court also gave judgment against clauses in the franchise relating to municipal ownership and arbitration.

Denison & Sherman (Electric).—A meeting of stockholders will be held July 21, to vote on an issue of $350,000 first mortgage 5 per cent. bonds, $250,000 of which will be applied to retire existing obligations, and $100,000 reserved for additions and betterments. A vote will also be taken to issue $50,000 6 per cent. second mortgage bonds, and $100,000 additional stock.

Jackson & Battle Creek Traction.—A mortgage has been made to the Morton Trust Co., of New York, as trustee, to secure $750,000 5 per cent. 30-year bonds. The company was incorporated last spring in Michigan to build an electric line from Jackson to Battle Creek, 42 miles, paralleling the Michigan Central.

Mexican Central.—Ladenburg, Thalmann & Co., of New York, and the Mississippi Valley Trust Co., of St. Louis, offer at 96½ and accrued interest, $4,000,-000 of collateral trust 5-year 4½ per cent. gold bonds, due Feb. 1, 1907, and a portion of an issue of $10,-000,000, of which $6,000,000 has been disposed of by private sale. The issue is secured by $16,129,000 Mexican Central consolidated 4 per cent. gold bonds, due in 1911, which are a first lien upon 2,689 miles of road, subject only to a lien of $288,000 old first mortgage bonds still unexchanged for consolidated mortgage bonds, and to $5,597,000 priority mortgage 5 per cent. bonds held by the Boston Safe Deposit & Trust Co. as additional security for the principal and interest of the consolidated mortgage 4 per cent. bonds. The consolidated mortgage authorized an issue limited to $32,000 per mile of constructed road. The consolidated mortgage is further secured by all equipment and terminals and by an $8,200,000 subsidy fund in the hands of the Boston Safe Deposit & Trust Co. The purposes of the issue are to redeem $6,000,000 of notes created in payment for the Monterey & Mexican Gulf, a line 390 miles long, to extend this line from Trevino to San Pedro, 150 miles, forming a connection between the Monterey & Mexican Gulf with the main line of the Mexican Central, and to pay the floating debt of the Mexican Central amounting to about $2,000,000, and "for other corporate purposes." The notes referred to were paid in full on May 15, and work on the connecting link has been begun.

New Hampshire Traction.—This is a New Hampshire corporation which owns and controls the Amesbury & Hampton; Seabrook & Hampton Beach; Haverhill & Plaistow; Haverhill, Plaistow & Newton; Portsmouth & Exeter; Dover, Somersville & Rochester; Exeter, Hampton & Amesbury; Hudson, Pelham & Salem; Haverhill & Southern; New Hampshire, Lawrence & Methuen; Lowell & Pelham; Rockingham County Street & Power, and Granite State Land traction lines, a total of about 135 miles of trolley line, including pleasure resorts and power plants, and serving a population of over 300,000. The funding of the company consists of $1,000,000 capital stock, and $7,500,000 first lien sinking fund 4½ per cent. 40-year gold bonds, without privilege of earlier redemption, for which the New York Security & Trust Co. is trustee. Of this issue of bonds, $6,625,000 is to be offered at the present time, the remainder being held in escrow to retire underlying bonds, and for future extensions and improvements. Chas. S. Fairchild, New York, is President, and Howard Abel, General Manager.

Norfolk & Western.—The Hillsboro R. R., which extends from Hillsboro to Sardinia, Ohio, 19 miles, and has been controlled by the Cincinnati, Portsmouth & Virginia, was bought by the Norfolk & Western June 25. On and after July 1 the Hillsboro line will be operated as a part of the Cincinnati Division of the Norfolk & Western.

Rhode Island Company.—This company has taken over under a 999-year lease the Union R. R. of Providence; the Pawtucket St. R. R., and the Rhode Island Suburban line owned by the United Traction & Electric Co. Under the lease the holders of the stock of this company will receive 5 per cent. dividends, and eventually a distribution of 25 per cent. in the stock of the Rhode Island Securities Co., which is to be organized shortly. The United Gas Improvement Co., of Philadelphia, subscribed for the $2,000,000 capital stock of the Rhode Island Co. The directors of the company are Martin J. Perry, of Providence, President; Randal Morgan, Walton Clark, Lewis Lillie and Thomas Dolan, of Philadelphia; Nelson W. Aldrich and others, of Providence.

South & Western.—The Ohio River & Charleston, which extends from Johnson City, Tenn., to Caney River, N. C., 35 miles, has been sold to the above, and the purchasing company is said to have authorized the issue of $600,000 of bonds with which to complete the building work already begun. The charter of the South & Western provides for a line from the North Carolina-Tennessee State boundary to a point on the Virginia-Tennessee State line in Sullivan County, with a right to extend beyond. (See under Railroad News, May 30, p. 404, and Railroad Construction, April 18, p. 296.)

Southern.—On June 30 this company resumed operation of the South Carolina & Georgia extension, running from Camden, S. C., to Marion, N. C., 145 miles. The purchase of this road was authorized by an act of the last Legislature in South Carolina and will give the Southern the shortest connection between Asheville and Charleston.

Virginia Passenger & Power.—This company on June 24 took possession of the Richmond Traction Co., the Virginia Electric Railway & Development Co., and the West Hampton Park Co. The total mileage embraced in the consolidation is about 130. The Virginia Passenger & Power Co. was organized in 1901, under special charter, and is capitalized with $3,000,000 stock, $15,000,000 first consolidated gold mortgage bonds at 5 per cent., and $1,000,000 South Side Railway & Development first mortgage gold bonds. Fritz Sitterding is President.